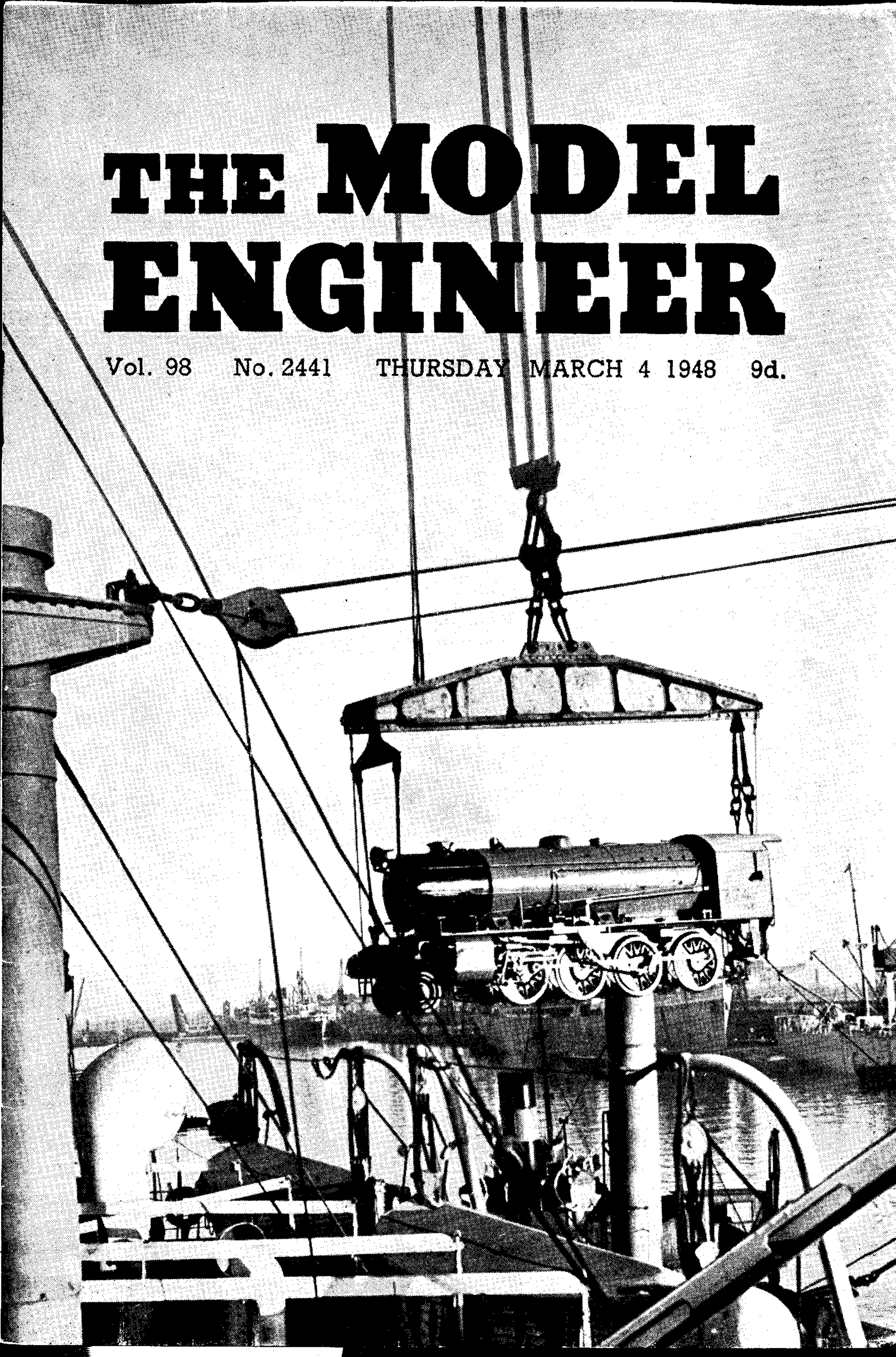
THE MODEL ENGINEER

Vol. 98 No. 2441 THURSDAY MARCH 4 1948 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

4TH MARCH 1948 VOL. 98 NO. 2441

SMOKE RINGS

Our Cover Picture

● A MEMBER of our production staff with a warped sense of humour once suggested that a large cardboard dummy cigarette be made, to be placed alongside such things as motor cycles and photographed against a plain background, thus producing a photograph of a "model" motor cycle. An object is only large or small by comparison with some other object; the photograph we have used this week illustrates this point. Comparison with the size of the ship together with perspective creates the illusion of a model locomotive.

Fareham Forges Ahead

● ONE PLEASING result of the recent excellent exhibition staged by the Fareham Society, as described in our issue of February 5th, is that the membership has been doubled. A further result is that the Society has been asked to put on a show for the Fareham Civic Silver Lining week which takes place from March 13th to 20th. The display will take place at the Connaught Drill Hall, Fareham, and will include controlled aircraft flying, race-car trials, and rubber-driven model plane flying. There will also be a passenger-carrying locomotive track in operation and a good show of larger models of all kinds. A new feature will be several work benches with juniors at work making models. Altogether Fareham is in for a busy time.

Are You One ?

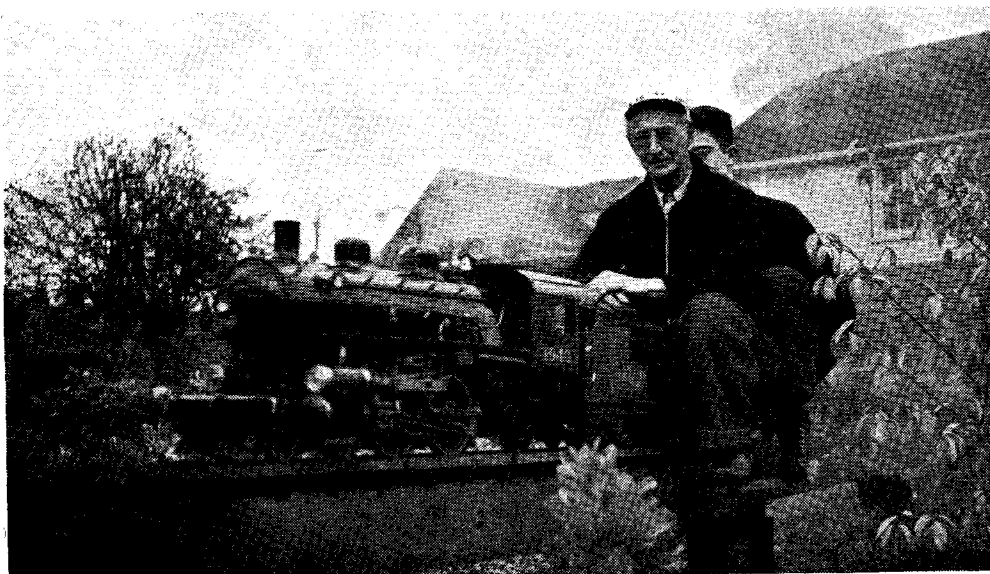
THE RESPONSE to the questionnaire published two weeks ago in the issue for February 19th has been very gratifying and helpful. A very large number of readers, however, have not yet completed the answers to our questions. If you are one of this number, may we ask you to turn up your copy of THE MODEL ENGINEER for February 19th and return the form to us duly filled in. If you are unable to make up your mind as to the exact order in which you would place all the items listed, it would still be very helpful if you will number the half-dozen which appeal to you most. Only by using your vote in this way can you assist us to select the articles which you enjoy.

Canadian Reminiscences

● A PLEASING letter from Mr. John E. Wood of New Westminster, B.C., a reader from No. 1, recalls some interesting experiences of both model making and real railroad engineering. Some examples of Mr. Wood's model making have been illustrated in our pages from time to time, notably in our cover picture of April 17th, 1947, and in our issue for October 1st, 1936, in which he figured in an interesting article entitled "A Model Engineer in Canada." I will not quote the many kind things Mr. Wood says about THE MODEL ENGINEER and its outstanding contributors, but here is a little experience from

real life which is of interest. He writes :—"When working as a fitter on the old Canadian Northern Railway in a prairie 'round house,' a passenger engine came in with the R.H. valve-gear wrecked due to a broken radius rod. This was the first engine on the prairies with Walschaerts valve gear, and the other fitters not being familiar with this gear were stumped. The locomotive foreman likewise, and he asked me if I knew anything about it. I replied that I had never worked on this gear, but guessed it could be figured out. After a couple of hours with back numbers of the 'M.E.' I went to work at 7 p.m. that evening, and in the morning the engine went out all square and O.K. Two months later I was promoted to be locomotive foreman at a busy prairie divisional point with eighteen to twenty locomotives under my care. In passing, may I say that if anyone wants a tough job, with long hours and lots of grief, try a locomotive foreman's job on the Canadian prairies in the winter. Later on as mechanical superintendent of a large concern where I was responsible for the production and maintenance of printing, lithographing, envelope and box-making machinery, I often delved into the good old 'M.E.' for a solution of some problem or another. Text-books, sure, one can find it in them also, but not with the same friendly and interesting atmosphere. Now, after a busy life, I have retired in B.C. where the climate is easier on old bones, and I still enjoy my workshop, though nearing 70. I have 450 ft. of track in $3\frac{1}{2}$-in. and 5-in. gauges, a N.Y.C. Hudson in $\frac{3}{4}$-in. scale and a 1-in. scale free lance Atlantic, American type, and also a 'L.B.S.C.' 'Maisie.' Here with kindred souls from Vancouver and New Westminster, many happy hours are spent. I am at present engaged on a 1-in. scale Pacific, of which I hope to send you some particulars."

I am glad to be able to give a snap of Mr. Wood on his home track with his fine Atlantic. This engine has cylinders $1\frac{1}{2}$ in. $\times$ $2\frac{1}{2}$ in., drivers $6\frac{1}{2}$ in., pressure 100 lb. per sq. in., grate area 50 sq. in., tractive effort approximately 65 lb., total weight (engine and tender) 215 lb.



Mr. John E. Wood with his "Atlantic" on his home track at New Westminster, B.C.

The Sheffield Exhibition

● THE FIFTH exhibition of the Sheffield Society is to be held during Easter week at the Central Technical School. Entries will be welcome from other societies and lone hands, all of which will be eligible for awards. Entry forms are obtainable from Mr. W. J. Hughes, 87, Hopedale Road, Frecheville, Sheffield. It is expected that helpful co-operation will be received from the local ship model, aero-model, and model yacht clubs, who have contributed so much of interest in the past.

The "M.E." Index

● SEVERAL ENQUIRIES have been received from readers anxiously awaiting the index for Vol. 97. These have now been printed and are being despatched. We are obliged to delay the printers until we know how many copies are required to satisfy the demand from both home and overseas. Any further requests should be accompanied by a stamped addressed envelope, and should be addressed to the Sales Manager at 23, Great Queen Street, W.C.2.

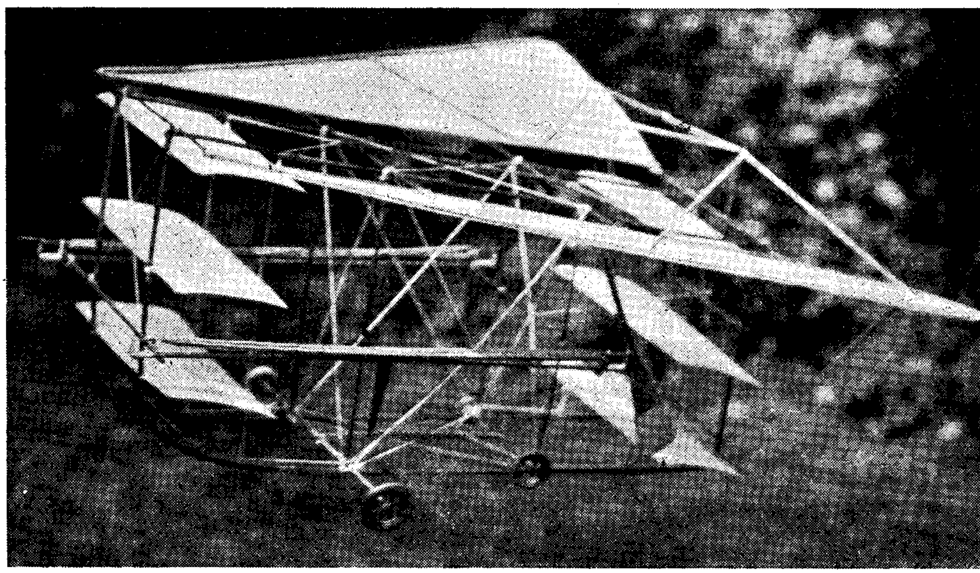
Percival Marshall

Models with a Purpose

by Donald Stevenson

THERE are two classes of model engineers, those who make beautiful scale models of things already in existence, and those who make working models to demonstrate new ideas. Both kinds are necessary, but it is a matter for regret that the latter appear to be dwindling in numbers, as it shows a decrease in initiative and enterprise.

One has only to go to model exhibitions and competitions to realise that this is the case. It is particularly noticeable in connection with aircraft models. When a model aeroplane does well in a competition, the majority of those made for a considerable time afterwards are merely copies of it, with only minor alterations to details, and in size, showing a lamentable want of originality.



Successful flying scale model aeroplane made in 1903. *Scale* 1 *in. to* 1 *ft.*

A Model-Maker's Thrill

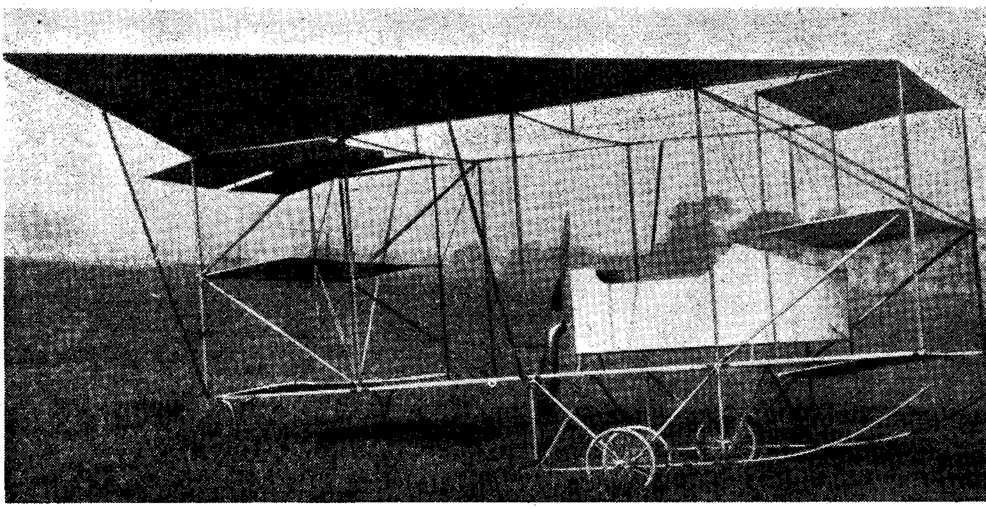
Every model-maker knows the thrill of looking at a beautiful scale model he has just completed, of some famous engine, ship or aeroplane, and all the fine workmanship he has put into it, but far greater are the thrills to be obtained from experimenting with a working model, made to try out some new idea. It brings with it something akin to the spirit of adventure in addition to the feeling of satisfaction at completing a fine piece of work, of something achieved, or anyway, tried, that may become of use to the community. The writer, who has been an enthusiastic model-maker for forty-seven years, is surprised, therefore, to see that the trend today is tending to make more and more of us become copyists instead of originators.

This cannot be due to any lack of inventive power because, as a nation, we lead most of the rest of the world in this direction. The greatest percentage of really important discoveries have been made in this country. Unfortunately, we are rather shy people, so perhaps it is due in some extent to self-consciousness. In these days of specialisation there are so many experts, in all branches of engineering, that one is apt to be nervous of displaying anything unorthodox because of a fear of being scoffed at by the specialists, or looked upon as a crank. This is a very serious matter, as in this way many good and useful ideas may be lost, just for the want of a little courage to try them out.

Jeers

Where would aviation have been today if inventors, in the early days of flying, had not been prepared to put up with a few jeers. In those days it was impossible to carry a model aeroplane through the streets without collecting a crowd, not of people interested in aviation, but a scoffing crowd which seemed to take a delight in seeing a model, perhaps the work of months, crash on its first flight.

Often the writer had to creep away at about three or four o'clock in the morning, to try out gliders and flying models, down the slopes of Richmond Terrace. Less than fifty years ago anybody who was enthusiastic about the possi-



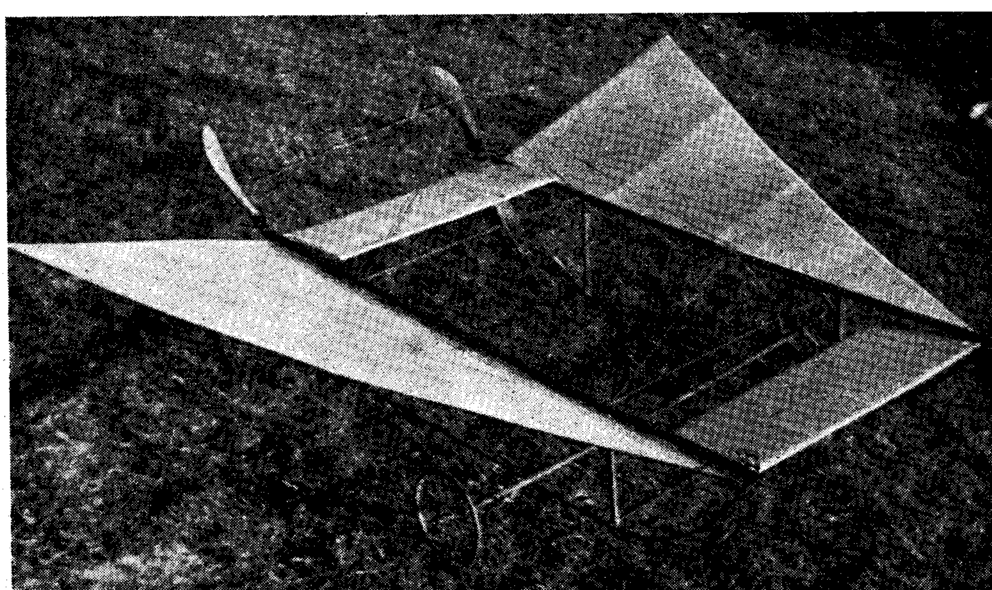
Quarter full size scale model made in 1910, and exhibited at the Aero Show, Olympia, in 1913

bilities of flying was looked upon as a fanatic, or a mild form of lunatic. People would come and admire one's designs and models, but as they went away they would shake their heads and say "poor fellow." In spite of this, model-makers persevered, and models were the first machines to fly.

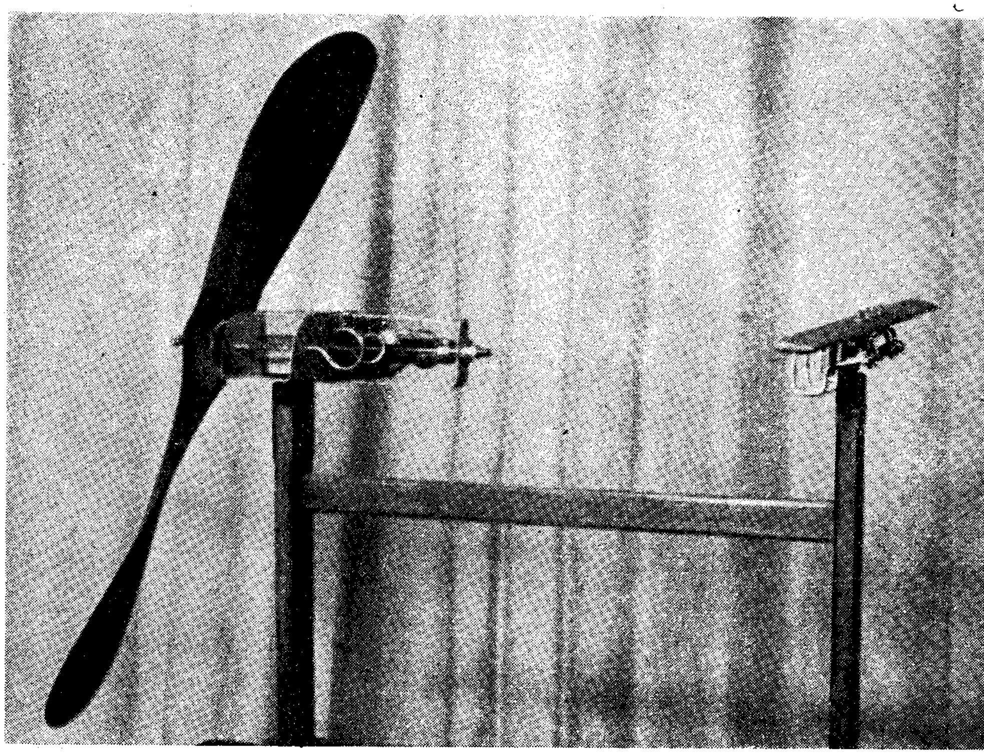
The photographs show only a few of the hundreds of models made by the writer, and which gave him so much interest and pleasure at the time, as well as a lot of knowledge and experience. Some of these models are still in working order.

The model aeroplane, made in 1903, was an attempt to make one that would fly and have inherent stability. The models justified the trouble taken. It was redesigned in 1910 in monoplane form and, with its swept back wings, was remarkably like the latest machines of today, but more stable and the speed could be varied while it was airborne, to give it low take-off and landing speeds. Unfortunately, it was too unorthodox in those days when aspect ratio was considered the chief importance.

The power plants were made to drive large experimental models. The engine of the steam



Flying scale model of same machine redesigned in monoplane form in 1910. Scale 2 in. to 1 ft.



Powerful rubber motor for four skeins of elastic, and with governor device to steady revolutions of propeller. Made in 1909

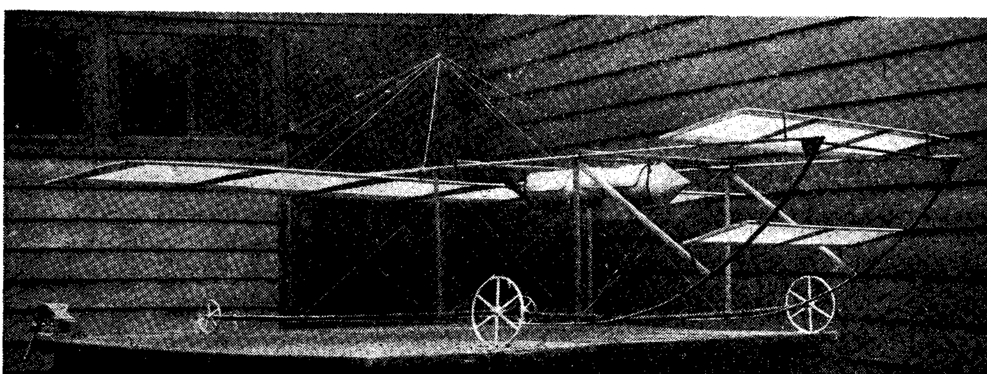
plant had a special rotary valve, which was afterwards patented. The speed was regulated by merely passing some of the water from the pump back into the tank through a two-way cock. The more water pumped into the flash boiler the higher the pressure and the greater the speed. The flash boiler worked at 150 lb. to 300 lb. per sq. in.

The petrol engine was not quite so successful. It ran only for brief periods then something would break. Many parts had been cut too fine to save weight.

The Rubber Motor

The rubber motor was interesting. The braking effect of the governor did not appear to absorb any power, but only to hold back the energy instead of allowing it to be used up with a rush at first, and it greatly increased the length of useful time it ran. The gear wheels, however, absorbed a certain amount of power.

Clockwork was also successfully tried on aircraft models. It should not be forgotten that the model which won the £50 prize given by

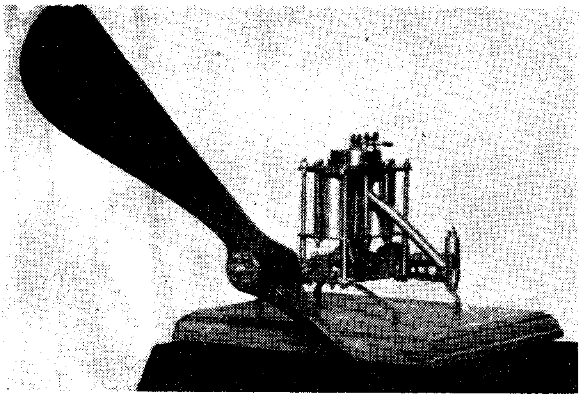


Steam-driven model aeroplane with 7 ft. 6 in. span. Made in 1911. *Power plant weighed* $5\frac{1}{2}$ *lb. complete with casing*

the *Daily Mail*, at a flying competition at the Alexandra Palace in 1907, was driven by clockwork. This form of power has been very much neglected.

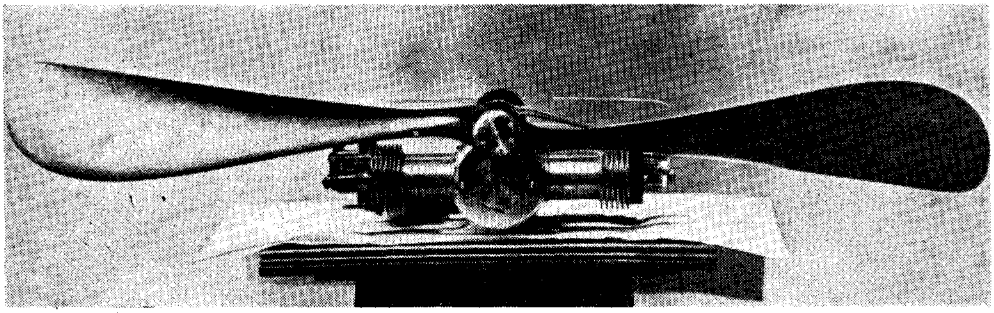
The model motor cruiser is another example of a model with a purpose. It was made before the cruiser was built and the experimental work in connection with the wheel-house was carried out on this model. The wheel-house was made so that it could be folded completely away, in under four minutes, for going under low bridges, or when a large open cockpit was desired. The mast and stanchions also folded down.

There are still endless experiments crying out to be tried, more than ever before in these days of mechanisation and increased scientific knowledge.

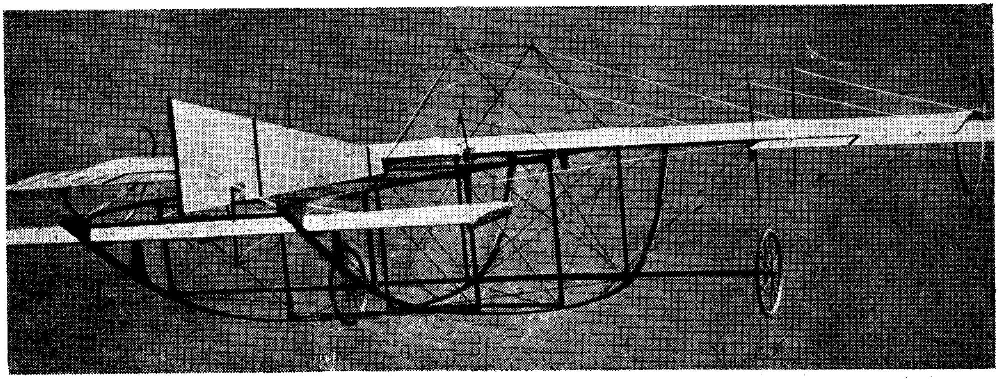


Engine of steam plant. Weighed 2¼ lb. and drove 20-in. propeller at 1,800 r.p.m.

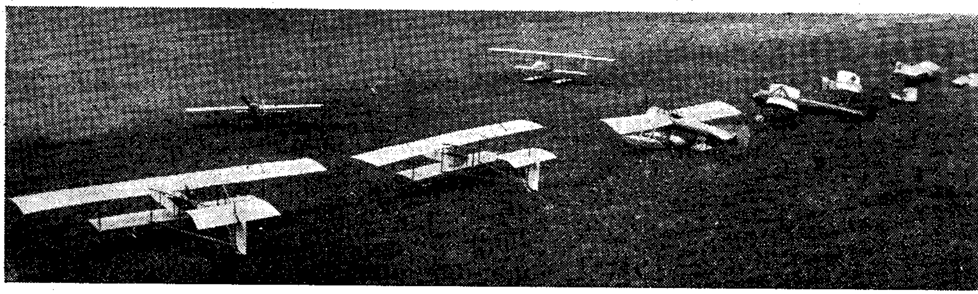
If you have a new idea, make a model of it and try it out. Perhaps it may not be very successful at first, or it may even seem a bit of a crazy idea; but who can tell until it is tried, it may develop and grow into an outstanding success. What does it matter if some people who may not understand or appreciate what you are aiming at, are sceptical and inclined to smile? If one idea in many is a success it is well worth while. You will have the satisfaction of knowing that you have really created something, or anyway tried, instead of being only an idle scoffer. Therefore, you model engineers, do not let those ideas of yours sink into oblivion without having a chance, give your brains an opportunity, and let us have more models with a purpose.



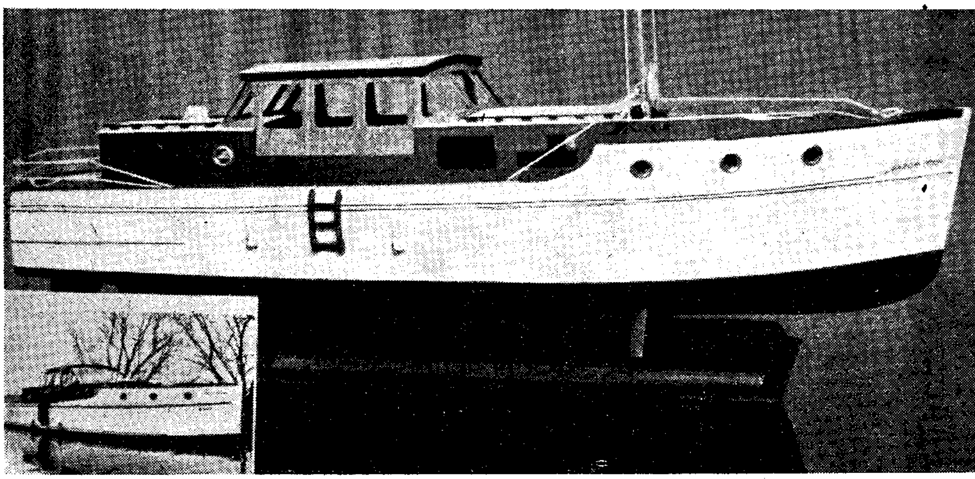
Small petrol engine made in 1911. Developed 1 h.p. and weighed 6 lb.



Model glider, 7 ft. 6 in. span, made in 1912 to demonstrate the working of the Mammett automatic stability device



Scale model aeroplanes made for the Imperial Services Exhibition, Earl's Court, in 1913, worked by a special apparatus designed by the writer. They took part in the Display of Aerial and Naval Battle, which was performed twice daily in the Empress Hall, as an example and warning of things to come. (This photograph was printed in "The Aeroplane," June 12th, 1913)



Scale model, 1 in. to 1 ft., of the writer's motor cruiser with folding wheelhouse. Made before the cruiser was built. Inset, the finished cruiser

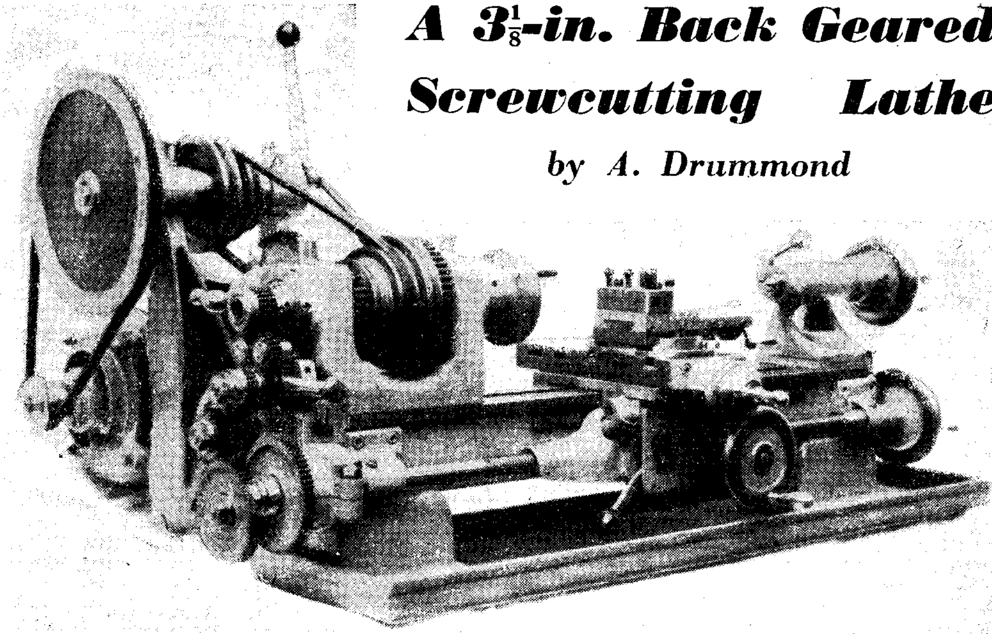
For the Bookshelf

G.W.R. Two-cylinder Piston Valve Locomotives, by E. J. Nutty. (Published by the Author, at 7, Bowood Road, Swindon, Wilts.) Price 2s. 3d. by post.

This is a handbook prepared to assist enginemen, firemen, running-shed fitters and apprentices in studying G.W.R. 2-cylinder piston-valve locomotives; yet we venture to think it will interest those of our readers who find pleasure in studying the technical aspects of locomotive design. The text explains and illustrates the main features of the valves and valve-gear fitted to the engines concerned, and it gives instructive advice as to what should be done in the event of failure of any of the parts. The illustrations consist of numerous line-drawings and explanatory diagrams to elucidate or amplify the text; by no means the least interesting of them is the drawing of the Swindon arrangement of the Stephenson link-motion as applied to all classes of G.W.R. 2-cylinder locomotives with outside cylinders. The book should fulfil its purpose admirably.

A $3\frac{1}{8}$-in. Back Geared Screwcutting Lathe

by A. Drummond



I HAVE wanted a lathe ever since I was fourteen years old, but could not afford one, and then came the war with its permits, followed by peace with its extended deliveries, so I finally decided to do as others have done, and build one myself.

I have been a constant reader of THE MODEL ENGINEER for a good number of years, and the efforts of others decided me to start.

I am fortunately placed in that my brother-in-law has a workshop complete with a $4\frac{1}{2}$-in. B.G.S.C. lathe, 0-in.-$\frac{1}{2}$-in. drill, and $\frac{1}{2}$-in.-$1\frac{1}{4}$-in. drill. After I had started, I bought a second-hand 9-in. shaper.

I had no experience of pattern-making when I started, and had resigned myself to fabricating a lathe bed, when a friend, learning of my intentions, gave me a block of cast-iron which was machined on all four faces. This decided the size of the lathe. The block was $1\frac{3}{4}$ in. thick × $2\frac{3}{4}$ in. wide × 24 in. long. The bed was not finished first, but I will deal with it first. The shaper I bought is a very old one with 2 ft. 2 in. of cross traverse, so that I was able to machine the bed with it. The bed was undercut and tee-slotted by winding the table back and forward by hand, which was a slow and tedious job, but finally produced the desired effect, as in Fig. 1.

I then drilled nine 1-in. holes through the bottom, so as to break into the tee slot. These holes were drilled in groups of three with 2 in. of solid between each group, and $\frac{1}{2}$ in. of solid between each hole, and 4 in. of solid at the tailstock end, and 6 in. at the headstock end (Fig. 2).

The bed was rough-scraped and left for nine months, while other work proceeded. After this time, the bed was finished scraped. The top was done first to straight-edge and surface plate. The lips were then scraped to the "mikes," followed by the edges, the front edge being scraped to the straight-edge, and the other three to the "mikes," and bedded with the straight-edge. At this point I decided that although the bed was rigid enough, it did not look deep enough, so I bought a bar of steel 1 in. × $2\frac{1}{8}$ in. × 24 in. and fastened this to the bottom of the bed with $\frac{5}{16}$ in. Allen screws.

The bed being finished, a bit of pattern-making was called for, and in this field I was very ably aided by my father-in-law.

When the castings were done, the headstock and tailstock were taken in hand. As I had not, at this time, any means of machining the bases, these were done out, but when I received the bill, it finally decided me on investing in the aforementioned shaper. After shaping, the headstock was tackled. This has a centre height of $3\frac{1}{8}$ in. and is fitted with opposed taper phosphor-bronze bushes. These bushes are $2\frac{1}{8}$ in. diam., with 8 deg. taper by 2 in long. To bore the headstock, I used a bar from a spindle moulder, having a suitable slot for the cutter, which I made myself from a piece of tool steel. The cutter is shaped as shown in Fig. 3, which also illustrates the section through headstock bearings.

The mandrel is $10\frac{1}{8}$ in. long, and is bored $\frac{5}{8}$ in. clear, with a No. 2 Morse taper. It is $1\frac{1}{4}$ in. × 2 in. long in the front journal and 1 in. × $1\frac{3}{8}$ in. long in the rear journal. It has a $1\frac{1}{8}$ in. × 12 t.p.i. nose, with a $1\frac{1}{4}$ in. diam. register. To make it, a piece of nickel-chrome steel, 20 in. long × $1\frac{3}{4}$ in. diam. was bought. This was centred, and then one end was turned to a few "thou" over the mandrel dimensions, the other end being turned down to a few

"thou" over 1¼ in. The whole bar was ground on all diameters.

The mandrel was then fitted to the headstock, and the protruding bar which projected over the bed was used for aligning the headstock by checking with a Starrett 1/1,000 in. dial indicator. The headstock was scraped to show no error in 10 in. of length.

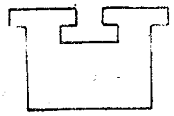


Fig. 1

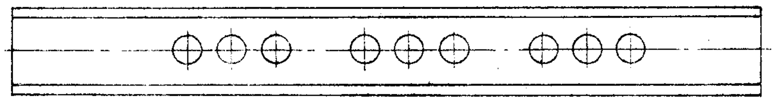


Fig. 2

I then assembled the headstock. The cone pulley was turned from an iron casting and grooved for standard section Vee belts. There is a 1 in. diam. heavy duty ball-thrust race in the rear housing, which is turned to form a cover for the thrust washer. The back-gear and tumbler reverse were then fitted. The gears are of standard manufacture, and bored out to suit my mandrel. A spring-loaded plunger is used to lock the back-gear to the cone pulley, which has eleven holes for the plunger.

The tailstock was then started on. This is bored for a ⅞ in. diam. barrel, which is 9 in. long, and bored ⅜ in. clear, with a No. 1 Morse taper. It is threaded 10 t.p.i. left-hand square thread. The handwheel and handle were first rough turned, and then finished with a hand-tool to the desired contour. The tailstock sets over ¼ in. either way, and is equipped with set-over locating screws, and clamped to the bed with a lever-operated cam lock. To ensure that the tailstock retains its accuracy regardless of wear by the saddle, independent fast sides are used, as in Fig. 4.

This also gives a long, narrow guide, which overcomes any twisting tendency.

The saddle was then shaped to size. Before I could scrape the saddle vees, I had to make a bedding strip. This was done and the saddle was scraped, but only roughly bedded to the bed. The cross-slide was then shaped. It is 3¼ in. wide × 7½ in. long, and has five ⅜-in. tee slots. This was scraped and fitted to the saddle, which was placed on the bed. I then clocked all four

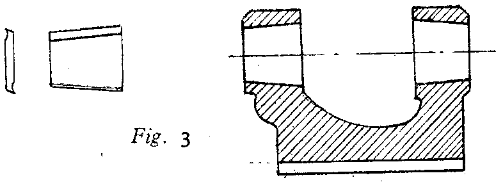
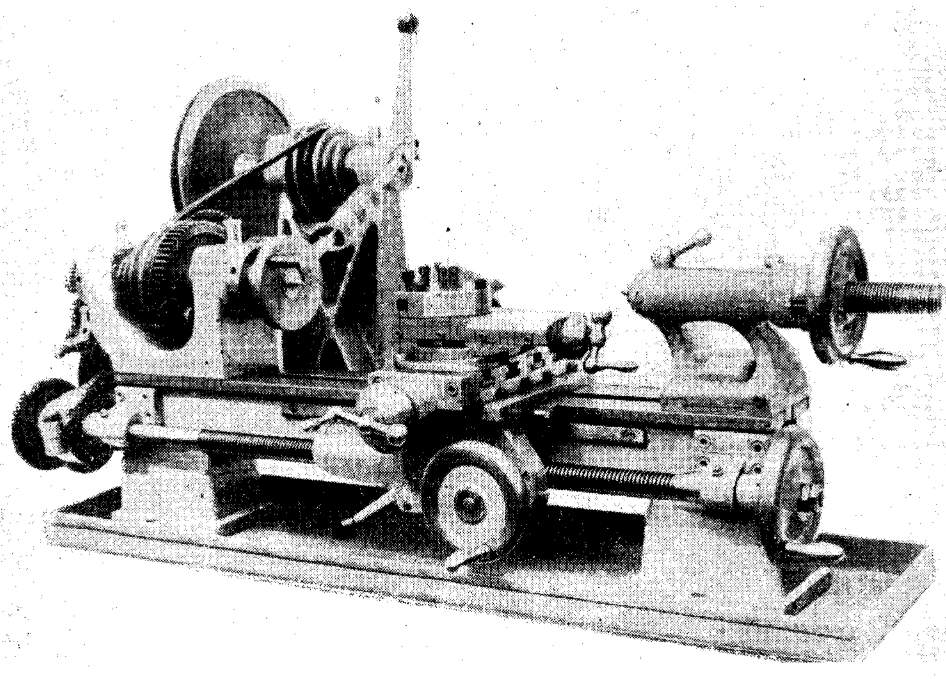


Fig. 3

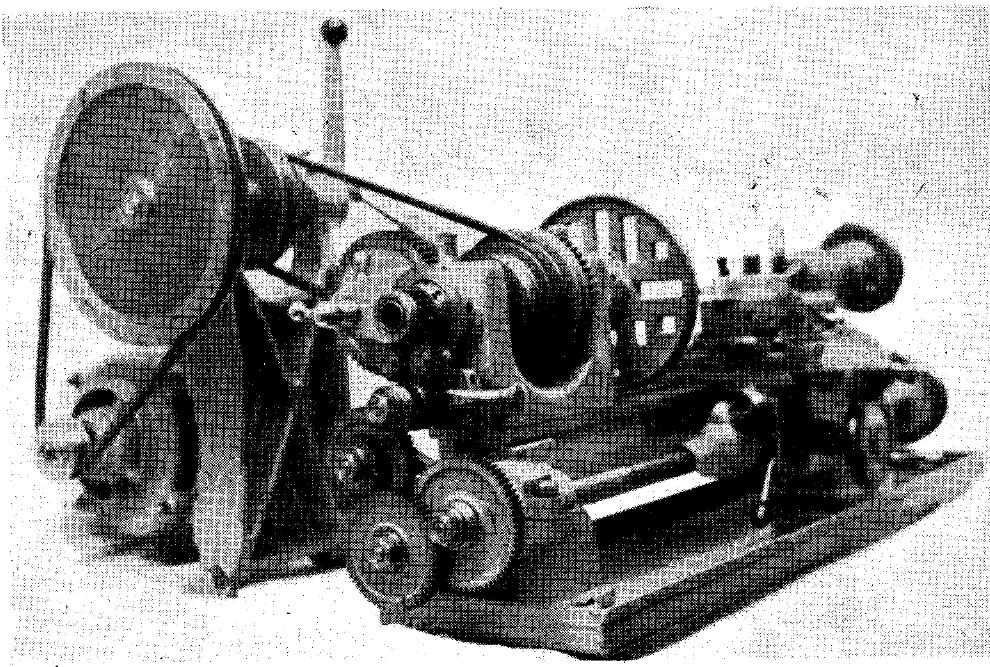
corners of the cross-slide, and bedded the saddle to the bed so that the top of the cross-slide was parallel with the bed.

The saddle handwheel is fitted with an idle wheel so that the saddle goes in the same direction as the handwheel rotates.



My brother-in-law's lathe was not long enough between centres to turn the leadscrew, so I had to buy one. The change wheels are also bought, and are a standard production.

The cross-slide has a 10 t.p.i. square thread-screw with a bronze nut, and is fitted with a 2 in. diam. 1/1,000 adjustable dial. It has $4\frac{1}{2}$ in. of movement. Before the strips were fitted, the slide was checked with the dial indicator for squareness with the bed. The topslide is fully compound, and swivels through 360 deg. It is indexed in 5 deg. The topslide has $2\frac{1}{2}$ in. of movement, and has a 10 t.p.i. square thread-screw with a $1\frac{1}{2}$ in. diam. 1/1,000-in. dial. The tool-holder is an idea of my own. When I was using my brother-in-law's lathe, I got "browned off" with playing about with bits of packing to adjust the tool, so I decided on the following idea. A block of steel was cut to shape and drilled as in Fig. 5.



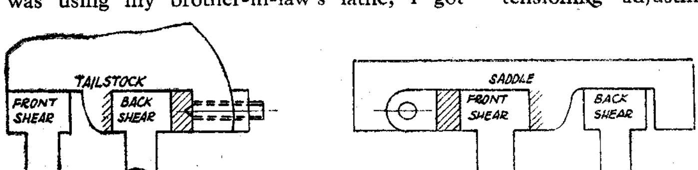


Fig. 4

This takes up to $\frac{5}{16}$-in. sq. tools, which are locked with $\frac{1}{4}$ in. Whit. Allen cap-screws. Three $\frac{3}{8}$ in. B.S.F. Allen grub-screws are used to adjust the tool to correct height, and once set, the tool can be swivelled to any angle without upsetting the height adjustment.

The lathe was now finished, and was given two coats of primer and two coats of light-grey cellulose.

The countershaft was now needed to complete the lathe. The bracket is of iron, and is cast in one piece, with lugs for the countershaft and facings for the motor, machined and scraped. Then the lugs were bored and faced for the shaft, which is 1 in. diam., and is made of K.E. toughened steel. The cone is of cast-iron and is a replica of the headstock cone, but the large reduction wheel is made of steel, and is 8-in. diam. The handle on top of the countershaft is to operate the belt change, and the adjusting link has a knurled nut, which gives $1\frac{1}{2}$ in. of tensioning adjustment. When the handle is

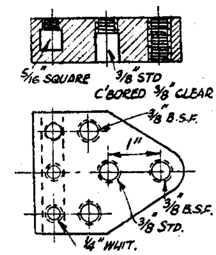


Fig. 5

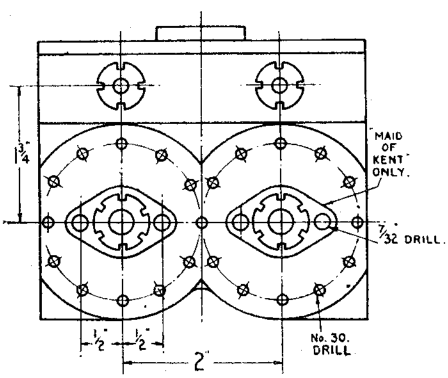
pulled back, the whole countershaft swings forward 1 in., which leaves the belt so slack that changing from one vee step to another is easily accomplished. A push of the handle, and the belt is immediately tightened to running tension. The handle locks on the "past dead

(*Continued on page* 249)

Cylinders for "Maid" and "Minx"

by "L.B.S.C."

CYLINDERS for the "Maid of Kent" and the "Minx" will probably be supplied with ports cast in, and I believe one advertiser proposes to supply the castings with ready-cored steam passages ; if the ports are as clean cast as those in the cylinders which I fitted to "Bantam Cock," they won't need any machining at all. Should the edges, however, look as though mice had been at them, they can be cleaned up with a small chisel, or trued with an endmill, by a method somewhat similar to that described for cutting ports from the solid. Briefly repeating once again for beginners' benefit, either use a commercial endmill, or a home-made slot drill (I prefer the latter, as it clears itself much easier

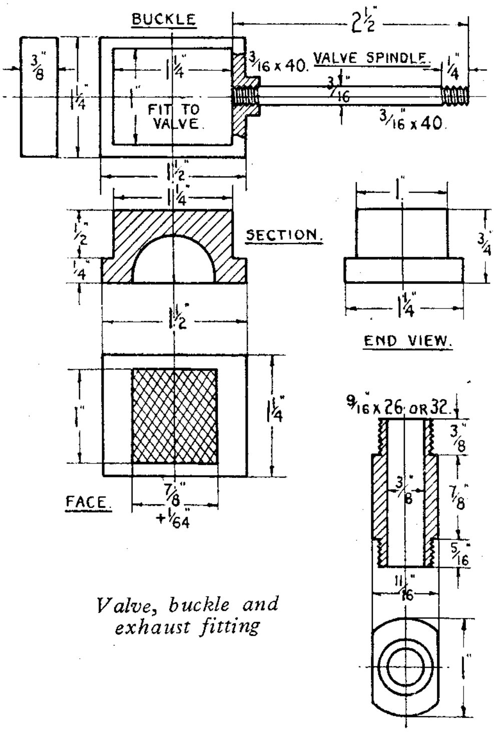


Back view of "Maid of Kent" cylinders

from chippings) held in the three-jaw, and mount the cylinder casting either on a vertical slide attached to the lathe saddle, or on the saddle or slide-rest itself, with packing underneath the casting, to bring the port location level with the cutter. It doesn't matter in the slightest, about the ports having rounded ends, instead of the squared ends shown in the illustration.

When cutting ports in solid casting, be careful to mark them out accurately. I always coat the port faces of my cylinders with a quick-drying fluid made by dissolving shellac in methylated spirits and adding a little colouring dye (blue or violet is best). This dries in a couple of minutes, and scriber scratches stand out on it like the rails at Clapham Junction on a sunshiny day. If you "get off the road," well, it's just your own fault ! The colouring can easily be rubbed off when the job is through, with a spot of "meth." (? poison-gas !) on a rag.

The actual job of cutting the port, is simplicity itself ; you just feed the casting on to the revolving cutter by moving the top-slide or saddle, and traverse the casting across the cutter by turning the cross-slide handle. Beginners should avoid "overshooting the platform," either by putting a stop on the slide, or noting the number of turns of the handle required to cut the first port, and keeping to the same number when cutting the rest. I use home-made slot drills for ports over $\frac{1}{8}$ in. wide (dental burrs do the job below that size) and go about $\frac{1}{16}$ in. deep at each traverse. Run the lathe at the highest possible speed without creating a miniature earth-



Valve, buckle and exhaust fitting

quake, and you'll get nice straight ports without ragged edges.

Ports can also be "gang-milled." For this operation you would need three cutters mounted on a spindle ; first a $\frac{3}{16}$ in., then a $\frac{3}{16}$ in. plain spacing collar, then a $\frac{1}{2}$-in. cutter, then another spacer, and finally another $\frac{3}{16}$-in. cutter. These would be run between centres on a fairly stout shaft. The casting is mounted on the saddle, parallel to the lathe bed, and fed straight into the cutters by turning the cross-slide handle, cutting the three ports at one fell swoop, using a fairly slow speed. Personally, I never use this method, because it doesn't cut the ports deep enough ; it merely leaves what I call three Woodruff key seats in the port-face. It could, however, be successfully used if four No. 20 holes were drilled down through the bottom of the "key seat" to connect with the four No. 20 holes forming the

passages between port and cylinder bore. Quite good ports can be cut by hand, drilling four or five No. 20 holes in the marked-out space for the steam ports, and a couple of $\frac{7}{16}$ in. holes in the exhaust port ditto, squaring up the whole doings by aid of a little chisel home-made from a bit of $\frac{3}{8}$-in. silver-steel, plus a smaller one with an edge $\frac{3}{16}$ in. wide, to finish the ends of the steam ports.

Drilling Passageways

Tackle the exhaust first. In the middle of the port-face, drill a $\frac{1}{8}$-in. hole about $\frac{3}{4}$ in. deep, and open it out with a $\frac{1}{2}$-in. drill. You'll find it far easier on a small bench drilling machine, to put a pilot hole in first; in fact, I nearly always drill a pilot hole for anything over $\frac{3}{8}$ in., although my pillar drill takes up to $\frac{7}{8}$ in. and has thirteen speeds—which called for a little jerrywangling when arranging countershafts and belts, but works fine! Tap this hole $\frac{9}{16}$ in. by 26, 32, or any fine thread for which you have tap and die available; the cycle pitch used in the bottom bracket of a push-bike does quite well. Now poke a 7/32-in. drill down one corner of the exhaust port, and drill into this hole (see cross section) then drill another hole beside it, in similar fashion. As soon as ever the big cavity in the slide-valve uncovers the steam port, the spent steam will make one flying dash down those two holes and up the blastpipe, producing the old familiar "L.B.S.C. chonk" which keeps the home fires burning without any back pressure in the cylinders. One of the secrets of success in my engines, is that the instant the piston passes "dead centre" it has full steam-chest pressure on the "active" side, and nothing at all on the "passive" or exhaust side, to hold it back. Beginners take note, that it isn't the *pressure* of the exhaust that creates the draught for the fire, but the *speed* at which it leaves the blastpipe tip. My compound "Jeanie Deans" is a striking example of this. The initial pressure in the l.p. cylinder is between 12 lb. and 13 lb. when hauling my weight at a speed equivalent to about 85 m.p.h., and with the way the valve is set, the exhaust pressure is pretty nearly at what the kiddies call "freezo," and you can't hear it; yet the spent steam scoots out of the blastpipe quick enough to maintain a healthy fire, and the safety-valve will start to raise a shindy if the firehole door is shut. The exhaust beats on the "Maid" and the "Minx" will be audible all right, as a "simple" engine naturally has a higher exhaust pressure than a compound; but the pressure will be at the minimum, especially when notched up. A gentle breeze at five miles per hour wouldn't blow your hat off, but the same breeze travelling at 80 odd, would flatten out your garden fence.

The four No. 20 holes, connecting bore with port, should be drilled a little on the slant, as shown in the section of cylinder. I do mine by holding the casting in a machine-vice on the drilling-machine table, end up, but canted slightly, so that the drill makes a bee-line for the port. It is quite easy to "sight" the drill by running it down outside the casting; you can see at a glance, how much to set the casting over, so that the drill breaks into the port a little below the edge, without chance of distorting the port-face. Make fairly deep centre-pops close to the edge of the bore, to give the drill a good start.

The holes may be drilled by hand, if the casting is held in the bench vice so that the holes will lie horizontally. The drill brace can then be held quite level, and there won't be any chance of the drill coming out on the port-face instead of going into the side of the port. When drilling small passageways, 3/32 in. or thereabouts, I usually advocate grinding the drill off centre, so that it cuts a bigger hole than its own diameter, and the bits can be easily shaken out, in case of breakage; but a No. 20 drill is not liable to break when used in a handbrace, so this precaution isn't necessary. When all sixteen holes are drilled, file a bevel across the holes at each end of each bore, to allow steam to pass into same when the cylinder covers are on. Finally, true up the port-face by rubbing it on a piece of fine emery cloth or similar abrasive, laid working side up on some flat surface, such as a surface-plate, or the drilling-machine table.

Cylinder Covers

There should be no difficulty about these. The castings will have chucking pieces cast on the outsides; and all the front covers will need, will be to chuck them by the spigots in the three-jaw, face off, turn the registers to fit cylinder bore, turn to correct diameter, cut off the chucking pieces, rechuck (either gripping by the edge, or else in a stepped bush held in three-jaw) and facing off the outside. Pieces must be filed away at each side, to allow the covers to fit, as shown in the view of the back covers, which also shows the screwholes.

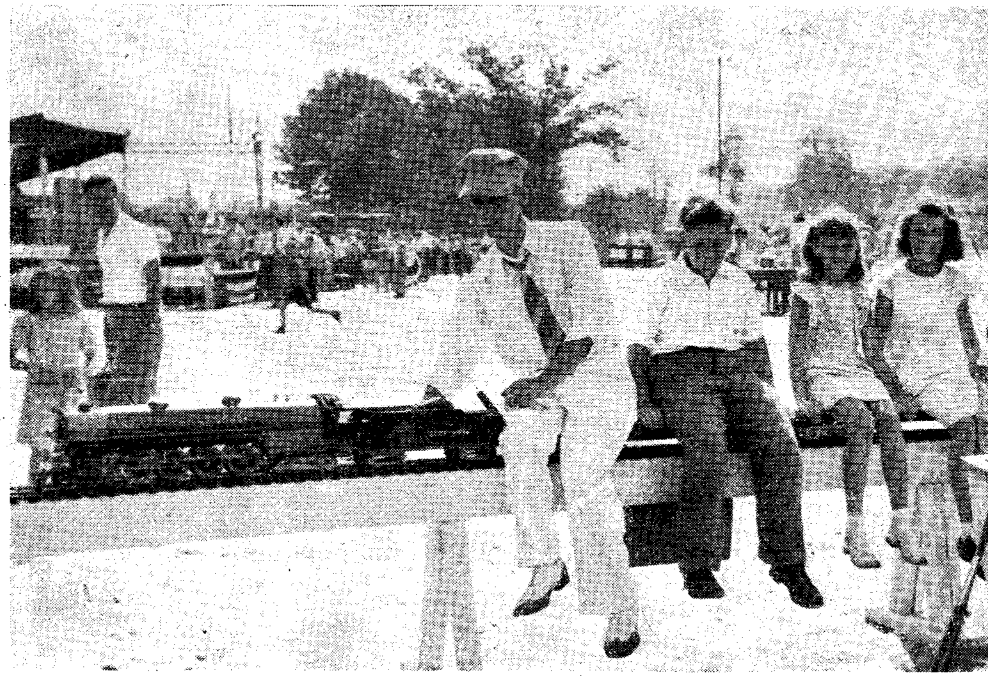
Very little extra work is needed for the back covers. Chuck by the tenon, and face off, turning the register to a tight push fit in the cylinder bore, and facing the flange; this should be finished with a knife tool, and the register a wee bit undercut, so that the flange makes proper contact with the cylinder casting. After turning to full diameter, centre the cover, and drill a $\frac{1}{8}$-in. pilot hole well into the chucking-piece; open out with $\frac{5}{16}$ in. clearing drill—letter O or 8 mm. if you have them—if not, just use an ordinary $\frac{5}{16}$ in. Saw off the chucking-pieces level with the gland boss; then rechuck, gland boss outwards, either holding direct by edge, or in a stepped bush, as before. The easiest way for a beginner to ensure true chucking, is to put a piece of $\frac{5}{16}$ in. round rod (silver-steel will be about the truest kind you could use) in the tailstock chuck; set the cover on it, open the jaws of the self-centring chuck sufficient to take the cover, or put the stepped bush in, whichever you are using. Then run the tailstock up to the chuck so that the cover on the rod goes between the jaws or into the recess in the stepped bush, as the case may be. Close down the chuck jaws, pull the tailstock away, and the cover is left in the three-jaw or bush, running truly.

Backstage whispers to our experienced friends—please tolerate these explanations. You've no idea how many beginners beg for them, and you were once in the same boat yourselves; I know I was!

Face off the gland boss to the given dimensions

and turn as much as you can off the rest, without cutting into the boss. The sides of same cannot be turned, owing to its oval shape, but if you hold a file against it, letting the file follow its movement, it will be cleaned up in two wags of a dog's tail. Open out the holes in the gland bosses to a full $\frac{1}{2}$ in., using a pin drill to make certain the glands will be concentric with the piston-rod, and tap $\frac{9}{16}$ in. by 32, or the same pitch used for the exhaust hole. Guide the tap with the tailstock chuck. Then drill the screwholes and fit the covers to the cylinders, setting the oval bosses horizontal as shown in the end view. Use $\frac{1}{8}$-in. or 5-B.A. screws, hexagon heads for preference.

The party who said I had forgotten the guide-bar holes, spoke out of turn. These are drilled after the back covers are fitted to the cylinders, to ensure that the bars are horizontal, and exactly at right-angles to the covers. Here is how you do it. Chuck a bit of $\frac{5}{8}$-in. brass rod in three-jaw, and turn down $\frac{1}{2}$ in. of it to $\frac{9}{16}$ in. diameter. Face the end, centre lightly with the smallest centre-drill you possess (I use a home-made one, a broken dental burr with a weeny arrow point ground on it; same one that I use for centring injector cones) screw the piece to match the thread in the gland bosses, and part off about $\frac{5}{16}$ in. from the end. Reverse in chuck and chamfer slightly, then make a sawcut like a screw-driver slot across the plain end. Screw this into the gland boss, flush with the face, centre mark outwards; you can turn it by poking a screw-driver through the piston-rod hole in the cover. Lay the cylinder block, port-face down, on the lathe bed; set your scribing block needle to the centre in the plug, and with that setting, scribe a line across the face of the gland boss. Ditto repeato on the second gland boss; then set your divider points $\frac{1}{2}$ in. apart, put one in the centre in the plug, and strike intersections both sides across the scribed line. Centre-pop the intersections, and drill the holes for the guide-bar spigots at those points, either on a drilling-machine, or in the lathe, removing the front covers so that the casting stands firm and true whilst drilling.



Al Milburn running "Lucy Anna" at the "Raybestos" family outing day, 1947

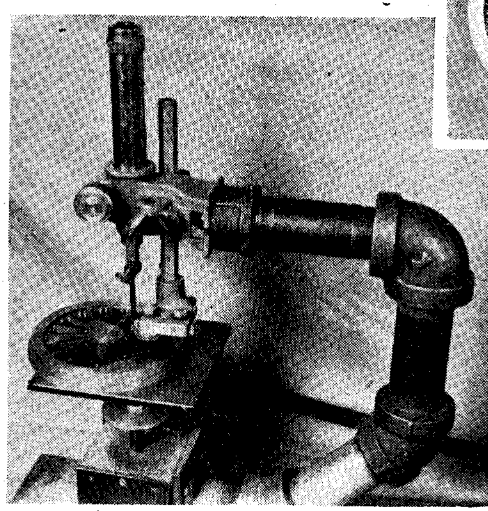
The glands are a kiddy's practice job needing no detailing out, and can be turned either from castings, or from $\frac{3}{4}$-in. drawn bronze rod. The point you want to watch, is to have the threads a nice fit in the stuffing boxes, neither so stiff that they need a C-spanner about 4 ft. long to turn them, nor so slack that they will work out when the engine is running. A friend had one work out when running, on a $3\frac{1}{2}$-in. gauge engine, and it made such a mess that the whole works had to be dismantled to put things O.K. again. It's the little things that matter; remember the tale of the kingdom that was lost because a nail came out of a horse's shoe!

Pistons and Rods

About the best material for the pistons, would be the same kind of alloy used for automobile engine pistons; and maybe our advertisers who sell cylinder castings for these engines, will oblige with the needful. If you can get a

couple of worn-out alloy pistons, you could melt them down yourself and cast a bit of round rod a full $1\frac{3}{4}$ in. diameter. Small foundry "pots," as the crucibles are called, are cheap, and sold commercially; and a 5-pint blowlamp, plus your brazing pan and some coke, would supply sufficient "therms" to melt the metal. Cast or drawn bronze or gunmetal rod would also do fine.

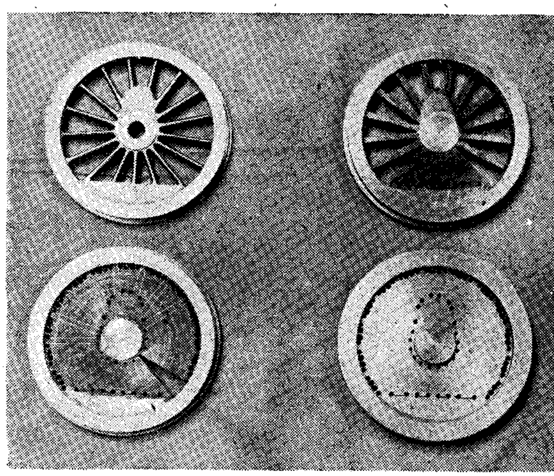
The piston-rods are made from ground rustless steel $\frac{5}{16}$ in. diameter. Cut to given length, chuck each in three-jaw, and screw $\frac{5}{16}$ in. by 32 or 40 with die in tailstock holder. Chuck the rod for the pistons in three-jaw; face the end, centre, and drill down about $\frac{7}{8}$ in. depth with letter J or 9/32 in. drill. Turn 1 in. of the outside to a little over $1\frac{5}{8}$ in. diameter, cut the packing groove, and part off $\frac{3}{4}$ in. from the end. Repeat operation; then chuck one of the blanks in three-jaw, open out the hole to $\frac{5}{16}$ in. drive fit (letter N drill) for $\frac{3}{8}$ in. depth and tap the rest to match the piston rod. Put a piston-rod in tailstock chuck, run it up to piston, enter the rod in the tapped hole, and pull the lathe belt by hand until the thread is right home and has drawn $\frac{3}{8}$ in. of the plain rod into the hole. The piston must then of necessity be true on the rod; and if the rod is then held either in a collet, or in a split bush held in the three-jaw (I have described the wheeze many times) and carefully turned to an exact sliding fit in the cylinder bore, you won't be troubled with steam blowing past nor will there be any undue friction. The above items should keep builders busy for the next week or so!



Jigsaw made from pipe fittings doing the job

A Friendly Rival to Dr. Winter

Al Milburn, of Milford, Conn., U.S.A., is literally carving a $3\frac{1}{2}$-in. gauge Atlantic locomotive out of the solid! That wonderful craftsman Dr. J. Bradbury Winter, who built the finest little locomotive I have ever seen (if I take to crime when my worn-out noddle finally cracks, there is going to be a peach of a snatch-and-grab raid at Brighton!) had no alternative to cutting all his parts from the solid, as no suitable castings were available, and nothing but "the best" would do. Friend Milburn could have used castings; in fact he has a very fine $2\frac{1}{2}$-in. gauge 4-6-4 built to instructions given by your humble servant in a now defunct American Journal, and a picture of her at work is reproduced here. However, he had the urge to follow the worthy Doctor's wonderful example, and is making a first-class job of it. The pictures show progress to date, and illustrate how the wheels were cut from $\frac{7}{8}$-in. steel-plate. They were first turned as solid discs, then the spokes were marked out, drilled at the rims as shown, and finally cut out on a jigsaw made up from pipe fittings. The smokebox was turned and bored from a solid piece of steel bar, the finished size being $4\frac{3}{4}$ in. diameter; and if that isn't some job, I'd dearly love to know what is! Chimney, domes, and all other parts for which castings are normally used, are all carved from solid steel. I am watching progress on this locomotive with great interest, and hope to give a fuller account, with details of performance on the road, at a later date. Meanwhile, congratulations to our friend on his skill, patience, and excellent workmanship.



Stages in cutting driving-wheels from solid steel

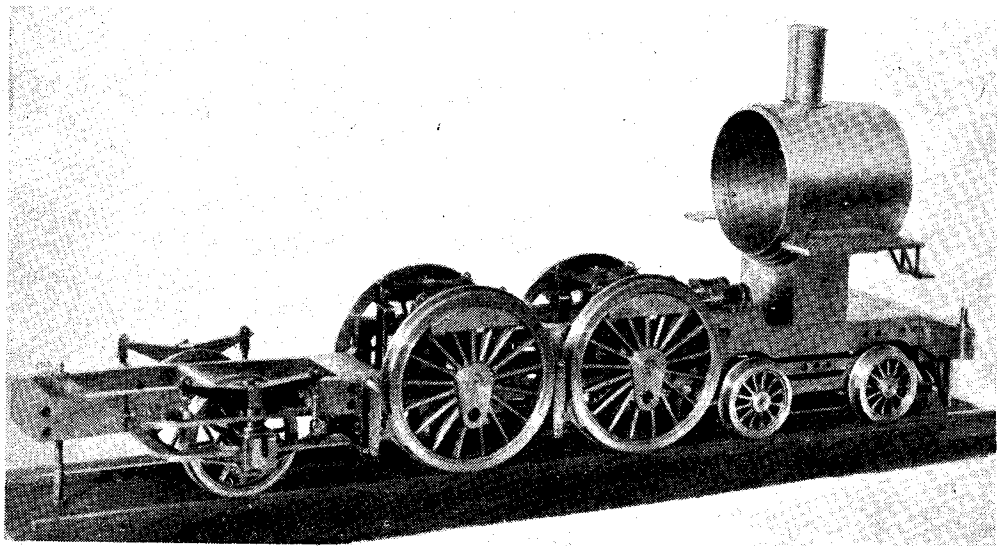
Valve Lag, or "Late Ignition"

I am afraid that Mr. A. J. Maxwell, in his letter on page 129 of January 29th issue, is speaking out of his turn, because *I actually am in regular communication with a number of G.W.R. drivers and firemen*, and therefore, quite cognisant with the method of working the G.W.R. locomotives with Stephenson link motion and long-travel valves. Many years ago, Mr. C. B. Collett, when C.M.E. of the G.W.R. paid a visit to my old workshop at Norbury, in company

with the late Sir A. Brocklebank, then a director of the G.W.R. and a real "live wire" on the question of locomotive efficiency. During their stay of about $1\frac{1}{2}$ hours, I learned a lot about G.W.R. valve gears and setting, "straight from the horse's mouth." I also have some official blueprints of the Swindon valve gears, including that of the latest "1000" (County) class, the latter being kindly sent to me by Mr. F. W. Hawksworth when I told him I was about to describe how to build a $3\frac{1}{2}$-in. gauge edition of his "280-pounder" and wanted to have it about right. I have also travelled many miles on the footplates of G.W.R. locomotives, and have thus gained first-hand experience; so I leave readers to judge for themselves as to my knowledge of G.W.R. locomotives and their working.

The late Messrs. R. E. L. Maunsell and J. Clayton, when C.M.E. of the Southern, and his assistant, also visited my workshop, and saw one of my engines under steam on the little railway. They also gave me a lot of valuable information about valve gears and setting (do I hear somebody saying "No wonder old Curly's engines do the job!") which I used to good advantage. I always recollect with a smile, Mr. Maunsell's friendly chaff about my 4-12-2 "Caterpillar." He said, "You can't run that engine on our road, she'll pull 500 wagons and we haven't got a siding long enough; besides, she would break all our bridges down!"

The comparison drawn by Mr. Maxwell between the G.W.R. and Southern engines, is merely a matter of opinion; there are good and bad engines in all classes, according to how they are handled and maintained; but I will concede Mr. Maxwell one point—from what I have heard, he is probably right in what he said about the "West Country" class! However, the whole question of "lead or no lead" boils down to one simple fact which any kiddy could understand. To get maximum efficiency from the engine, full pressure must be available on the piston heads at the exact instant the crank passes dead centre; and to get that, it is obvious that the port must open *before* dead centre, as the steam takes time—little, it is true, but time all the same—to enter the cylinder and build up to full pressure. An engine with late admission will run, but an engine with early admission will run better, and use less steam. It will be interesting to compare the performances of the two engines mentioned by Mr. Maxwell, with some of the "Minxes" that are now being built, especially those with Joy valve-gear and a constant lead!



Al Milburn's "cut-from-solid" Atlantic progresses

A Back Geared Screwcutting Lathe

(*Continued from page* 244)

centre" principle—the tighter the belt, the tighter the lock. After the countershaft was painted, everything was ready for a run. The motor was wired up, and at long last, after two years of spare-time work, about 800 hr., my wish came true. The lathe runs very quietly, and after running it for two or three hours, I first turned the faceplate, which is 6 in. diam., and the ease with which this was done assured me that the lathe was more than capable of turning anything in its capacity. Two back-plates were then turned up, and a 3-in. three-jaw, and a 4-in. four-jaw chuck were fitted. As a test cut, a piece of $\frac{1}{2}$-in. bar was reduced to $\frac{5}{16}$ in. at one cut, with the primary belt fairly easy.

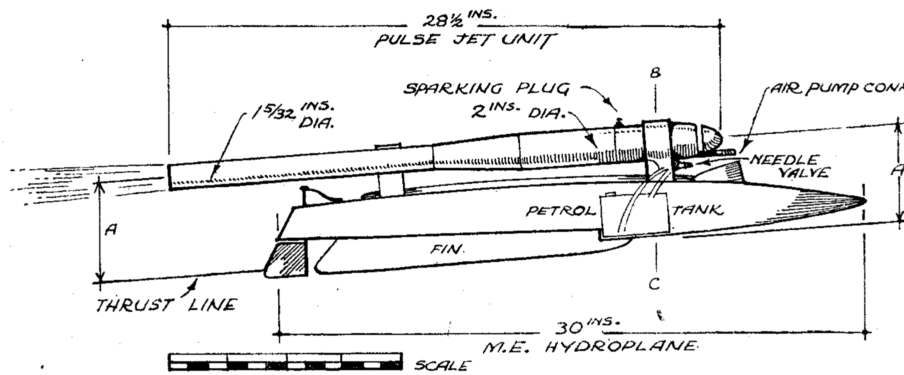
I hope that this article will serve to encourage others, as previous articles have encouraged me.

A Jet-Propelled Hydroplane

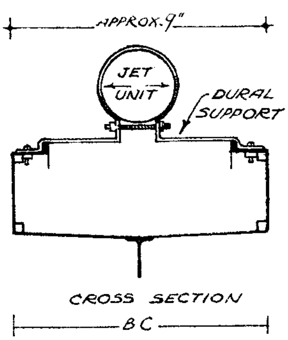
by K. J. Winkles

IN THE MODEL ENGINEER of November 20th, 1947, there was an article entitled "Power Boating in Chicago" in which a photograph of a hydroplane mounting a jet unit was shown, and a few words about it were given.

Two or three local model engineers have recently been in the position to carry out tests with a similar boat and unit, and their experience may interest other enthusiasts. *The unit* is a



"Mini-Jet" of American make, loaned to us by a member just returning from America.



The boat is a 30-in. version of the "M.E." hydroplane, but has a keel and rudder as shown in the accompanying drawing. It was previously a free-running boat with an airscrew and petrol engine. Although speedy, it was somewhat erratic, due, no doubt, to airscrew torque. The hull, weighing 1 lb., is constructed chiefly of aero-grade plywood on aluminium formers, with dural sheet for keel, transom and forward coaming. The construction is as described in THE MODEL ENGINEER of October 17th, 1946. Resin glue was used throughout, and most of the joints are only glued, but were set while under pressure. The finish is silver cellulose sprayed as for aeroplane work.

The jet unit was mounted by forming carrying supports of dural sheet, and these were bolted to the decking as shown in cross-section drawing.

The tail of the unit was packed around with asbestos, as it gets very hot when running, and we were anxious not to transfer too much heat to the woodwork.

A lonely shallow pond some 150 yards long was located for the first test. A floating test was made, and the centre of balance was about 2 in. behind the step; not quite correct, but we felt that we did not mind this, not knowing quite what to expect, and thought it might be better if she was a little sluggish in planing. A magneto was used for producing the spark, and a motor-tyre pump for air. Fuel was of a high grade, unleaded octane. We, three members of the local M.E. club, managed to get the unit started after a few teething troubles. The noise was somewhat demoralising, and one found oneself thinking of it as a weapon!

Nos. 1 and 2 members had the hard work—working the pump and magneto.

No. 3 member had to be very careful, not to touch the hot unit or point the tail at anyone.

The greatest difficulty for him was launching, as he was unable to stand behind the unit because of the immense heat projected, and therefore was unable to get correct aim.

The wind was about 10 to 12 m.p.h., causing decided ripples on the water.

We made four runs as follow:

Run I. Approx. 30 yds. The jet stopped; but just as well, as the aim was not too good.

Run II. Approx. 100 yds. The hull was planing well, accelerating steadily, but the speed was difficult to judge; the boat finished by crashing into a soft bank, with no damage.

Run III. Approx. 150 yds. The boat went well, ignoring all obstacles, including a partly submerged hawthorn bush, which it simply tore through, once more finishing up by hitting the bank a glancing blow and turning over, causing a cloud of steam from the tail unit.

Run IV. Very short, owing to lack of fuel, but very good. Runs were all made into the wind, and so had some effect on steering, as the hull was well out of the water on longer runs.

Our future intentions are to go on the river in a boat on a calm day, and "let her rip"! and make an effort at timing: but owing to deep water, have decided to prevent possible sinking and final loss by making a water-tight hull.

PETROL ENGINE TOPICS

*A 10-c.c. Flat Twin Two-Stroke Engine

by Edgar T. Westbury

AT the time of writing, the die-castings for the front and back housings are not yet ready, but sand castings are available, and are quite satisfactory, as detail accuracy of external shape is not so critical as with the body. The machining of these parts is quite straightforward, and most of the essential work can be carried out at one setting.

I recommend that the casting for the front housing (Fig. 4), should first be set up in the four-jaw chuck, with the inner face flat against the chuck back and the nose of the casting set to run as truly as possible. A light cut is then taken over the nose, for a length of about $\frac{3}{8}$ in., with the object of producing a true and parallel surface for further operations.

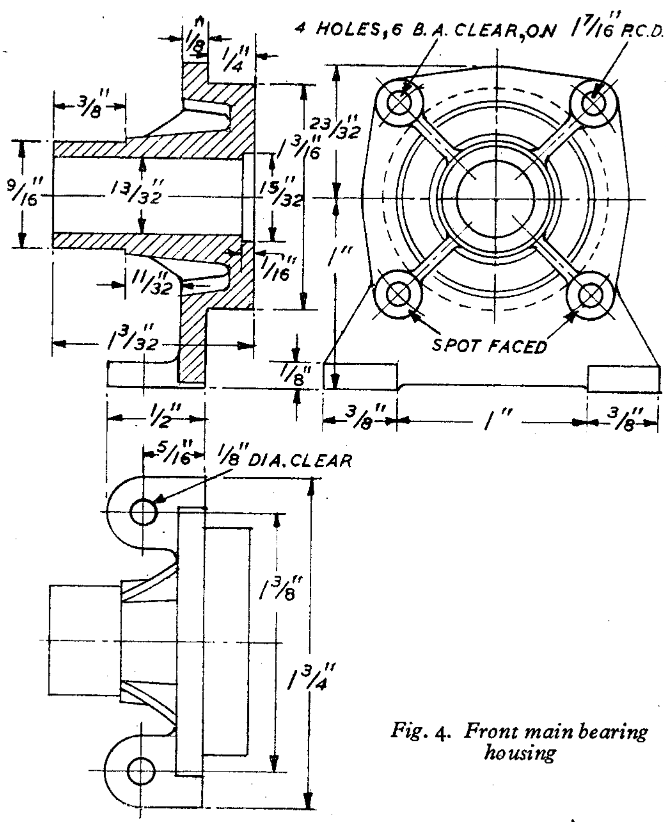


Fig. 4. Front main bearing housing

The casting is now reversed, and may be held by the nose in the three-jaw chuck, provided that the latter is reasonably true. See that the face of the casting runs truly, then run the centre-drill in, so that the back centre may be used to support the work for turning the spigot and inner and outer faces. There is a fair amount of metal to remove from the sand-cast housings, and it may be found that when taking deep cuts, there is a tendency for metal to build up on the tool point, resulting in a poor finish. This metal must be removed by oilstoning before taking the finishing cut ; a keen and well-raked tool will produce the best results. Drill the centre of the casting about $\frac{3}{8}$ in. diameter, and bore out with a small boring tool, using a reamer or D-bit to finish the bore, if available.

In order to facilitate mounting the engine, the bearing housings are now supplied with flanged feet, which, if not required, may be cut away. The machining of the under surfaces of the feet may be carried out by mounting the castings on an angle plate, by a single bolt through the bore, again not forgetting the slip of paper under the machined face. Plenty of metal is left on the feet, so that some latitude is possible in the dimension from base to shaft centre; but, in any case, careful measurement from the base to the spigot of the casting should be taken to ensure that the height is the same for both housings.

An alternative method of mounting the housings for machining the feet would be to clamp them together, face to face, with a close-fitting aligning bolt or dowel bush to preserve the register, between two angle brackets similar to those used for machining the body. This will ensure that both castings are exactly the same height from feet to centre, but care must be

*Continued from page 200, "M.E.," February 19, 1948.

taken to see that the clamping bolt is dead parallel with the faceplate.

The seating on the outside of the housing nose may be finished by mounting the casting on a mandrel, and it can be machined to correct length at the same setting.

Rear Housing. (Fig. 5)

General procedure is the same as for the front housing, but in addition to the operations already described, the boring of the inlet passage and the cavity in the rotary-valve seating face have to be considered.

of the communicating passage will still be desirable to minimise restriction and abrupt change of area.

It may be noted that some alterations have been made in the inlet port arrangements in the course of development of the engine design, and some castings are in existence having the inlet port entering obliquely, and intended to be drilled across to take the jet tube, thereby dispensing with the need for a separate carburettor. This type has been discarded mainly in order to simplify construction and improve adaptability; but, if it should be encountered, machining procedure differs only in the set-up for boring the inlet port, which calls for a compound angle fixture, specially made or improvised for this operation.

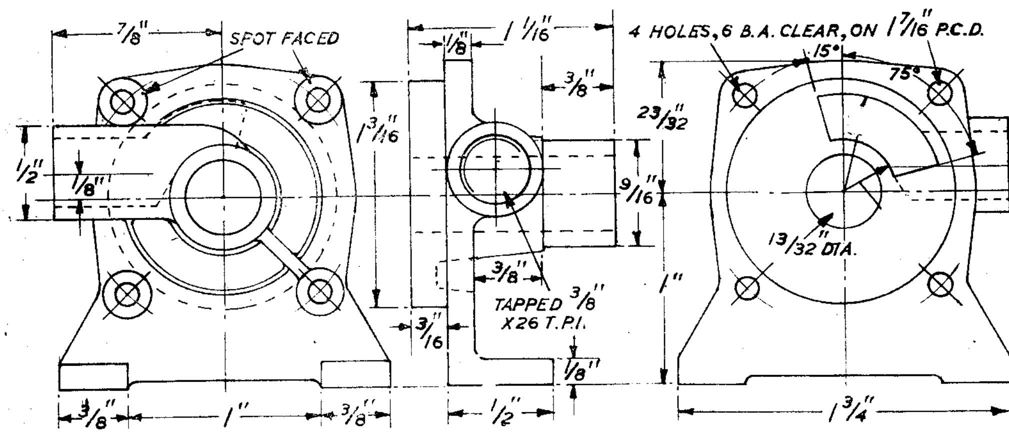


Fig. 5. Rear housing, with inlet stub

The former operation may be carried out on an angle plate, as described for machining the feet, the latter surface being in this case set square with the faceplate, and the angle plate then being adjusted to bring the boss central. After facing the latter and centring it, a 21/64-in. drill is run into a depth of ½ in., and tapped ⅜ in. by 26 t.p.i.

The valve port cavity is best produced by end milling, the most convenient method being by using a rotary end-milling spindle on the lathe cross-slide and a worm indexing gear on the headstock. It is not absolutely essential that the ends of the segmental port should be radial as shown; a round-ended port as produced by a ¼-in. end-mill is quite satisfactory, resulting only in a slight reduction of port area, the effect of which would only be noticed at extremely high speed, if at all. The port should, however, be kept within the angular limits specified, though here again, critical accuracy is not essential, except for super-tuning.

The port cavity should be at least $\frac{3}{16}$ in. deep, and at the end nearest the inlet port, a ¼ in. hole should be drilled at an angle from the bottom of the cavity, and afterwards riffled out to provide a smooth continuous passage of maximum permissible area within the limits imposed by the cavity and inlet passage respectively.

When the die-castings for the housings are produced, it is expected that the port cavity will be cast practically to finished size, removing the necessity for milling; but some fairing out

Cylinder-Heads. (Fig. 6)

The machining of this component is quite simple, as all the essential turning can be carried out at one setting by mounting it in either a three-jaw or four-jaw chuck. Care is necessary in machining the front face and recess, so as to ensure that an accurate pressure and joint is obtained. An important factor in ensuring an efficient seal, in cylinder-head joints, is to make the actual joint surface fairly narrow so that a very high pressure, in terms of pounds per sq. in. of face area, is obtained by moderate tightening of the bolts. In most of my engines, the joint is made between the inner face of the cylinder-head recess, and the projecting spigot of the cylinder and liner; it is not advisable to make the joint between the wider flat faces, especially as these are interrupted by the bolt holes. The surfaces should, therefore, be machined in such a way that a slight but distinct clearance should be left between these surfaces. A certain amount of distortion of the head or the cylinder, or both, usually takes place during the running-in period, so that the joint becomes leaky, but when this incidental "heat-treatment" is completed, re-lapping of the joint will ensure that it remains tight indefinitely.

The dimensions given for the inside depth of

the head produce a fairly high compression ratio —about $7\frac{1}{2}$ to 1, when allowance is made for the deflector notch in the piston and the sparking-plug pocket—and I do not recommend that this should be exceeded in the initial stages of the engine's working life. There is, on the other hand, much to be said in favour of lowering it, by deepening the combustion chamber recess, in cases where high performance is not the most vital consideration, as this results in a lowering of maximum stresses throughout the engine, improving smoothness of running and reducing "temperament." Exact matching of the dimensions of the two heads is important, to ensure that each cylinder does an equal share of work. It will be noted that the pistons over-run the ends of the liners slightly at both ends of the stroke, with the object of keeping wear as even as possible and improving oil film distribution on the working surfaces.

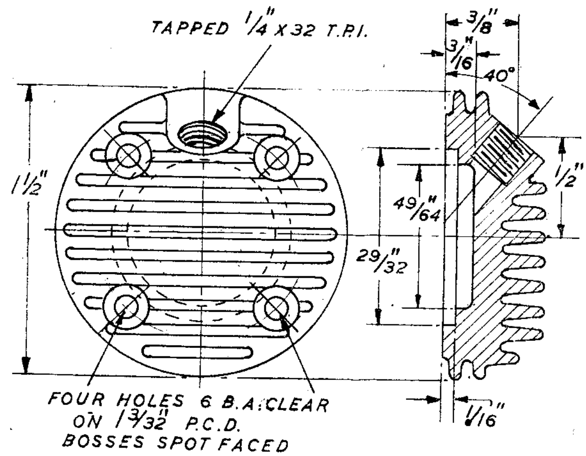
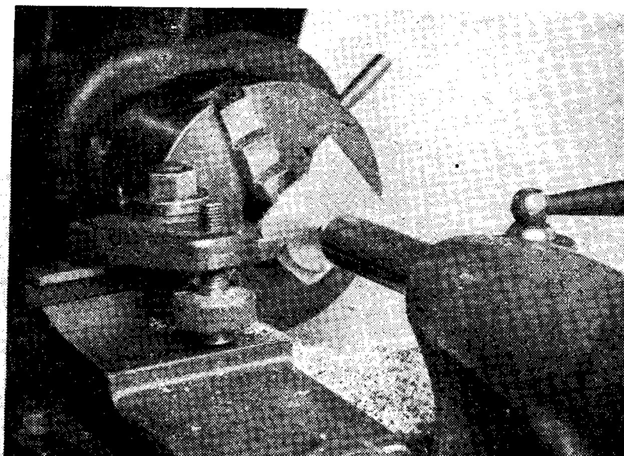


Fig. 6. Cylinder-heads (2 off, light alloy)

It is strongly recommended that the sparking-plug holes should be drilled and faced by setting the heads up in the lathe at the required angle and location. Although it may seem to be just as efficient, and much quicker, to drill the holes in a drilling machine and spot-face the bosses with a pin-drill, I am constantly encountering cases of heads being spoiled, and sparking-plug joints permanently leaking, by using these "time-saving" [?] methods; quite recently, a friend of mine, who is by no means a novice in these matters, and who owns an expensive drilling machine with "all modern inconveniences," succeeded in ruining the casting for the head of his "Ensign" engine in this way.

In the absence of a swivelling angle-plate (I made my own, by the way, and it has repaid the trouble taken many times over), it is quite a simple matter to plane up a block of hardwood to the required angle, and attach the cylinder-head casting to it by four wood screws through the holes for the holding-down bolts. The block can then be mounted on the faceplate, and set up to bring the sparking-plug boss central. Having faced, bored and tapped one head, the other can be put in its place without shifting the block, and uniformity of location and angle thereby ensured. Exactness in either respect is much less



Right. — Machining the front main bearing housing

Left.— Drilling the inlet passage in rear housing

important than making them exactly alike.

It will be seen that the tapping of the plug holes is carried out only to the depth required for seating the plug, but if it is found more convenient to run the tap right through—as for instance, if only a taper or "second" tap is available—the unwanted threads inside the head should be machined away, by mounting the castings on a screwed plug mandrel (an old sparking-plug body will do), so as to rotate on the axis of the plug. This procedure will lower compression slightly, but will not produce any

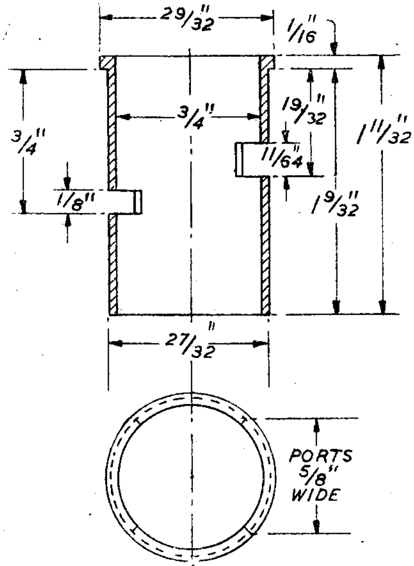


Fig. 7. Cylinder liners (2 off, steel or cast-iron)

ill effect. All burrs or knife-edges inside the head should be meticulously removed.

Cylinder Liners. (Fig. 7)

Steel liners have been used in the engine under test, and have given good results on the whole, but my original contention that you cannot beat good cast-iron for this purpose remains unshaken. There is, however, a good deal of difficulty in getting sand-cast liners of assured and consistent quality, and supplies of centrifugally cast-iron are more difficult still, so it is necessary to legislate for what is readily available. It is possible to improve the working quality of steel cylinders by internal carburising, as I have described on previous occasions, and this treatment, if adopted, should be carried out after major machining, but before final finishing of the liners. The internal and external machining can be carried out at one setting, by allowing a substantial chucking-piece on the bar or quill.

After many years of experience in the fitting of thin liners to cylinders, I have come to the conclusion that many of the troubles encountered with them arise through trying to fit them too tightly, so that they are constantly in a state of stress. As the liners in this engine are located and clamped by the top rim, they only need to be in sufficiently close contact with the housing to prevent gas leakage between the exhaust port and the crankcase; and for this purpose, little more than a good "wringing" fit is needed; for those who have a passion for exact measurements, this means not more than 0.0005 in. interference. *But the surfaces of both housing and liner must be accurate.* To facilitate insertion, the lower end of the liner, from just below the exhaust port, may be very slightly relieved or tapered, and it should be possible to push the liner at least half-way in by hand.

After machining and rough-lapping the liner, the ports should be cut, that for the transfer being finished before insertion, though final finishing of the exhaust port may be left till afterwards. A convenient way of forming the ports is by side milling, using a slotting cutter on an arbor held in the chuck, and clamping the liner to the side of an angle-plate or other vertical fixture on the cross-slide, by means of a bolt through its centre. This method not only enables a square-cornered port to be cut, which is impossible when an end-mill is used, but it is also quicker, and facilitates accurate measurement and uniformity of the two liners. Internal burrs should be carefully removed, and finally, lapping carried out after the liners are inserted. All the instructions which I have given in the past for the accurate finishing of cylinder bores apply in full force here, and if constructors fail to obtain results from the engine for the want of care and patience in this operation, they have only themselves to blame.

(To be continued)

Making Hexagon-Headed Bolts

V. J. Watson writes:—"Faced with the difficulty of obtaining supplies of small hexagon-headed bolts and screws, and also that the proverbial 'bag of gold' will not produce any small hexagonal bar, I venture to put forward an idea of mine which I found solves the problem extremely well, especially should finished models appear under the X-ray eyes of THE MODEL ENGINEER Exhibition judges, who pounce upon slot-headed screws with wild abandon.

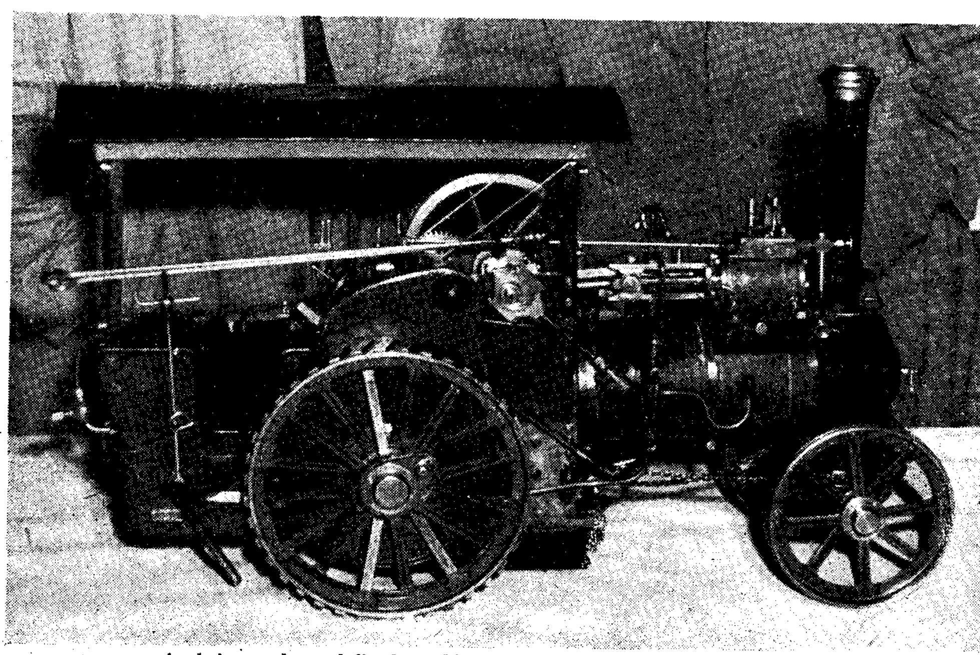
"From the nearest tool stores I purchased a few of the smaller sizes of Allen keys which are hexagonal in cross section, the smallest being approximately $\frac{1}{16}$-in. A.F. The said keys were subjected to an overnight dose of annealing in the kitchen fire. This I found softened the keys enough to enable the necessary machining to be carried out.

"Cutting the smaller bent end off, the key is mounted in a 3-jaw chuck, turned to the requisite diameter, screwed, parted off and, hey-presto, the finished hexagon-headed bolt appears to replace that monstrous slot-headed screw. The sawn-off end of the key can be utilised to make nuts to match the bolt if necessary. I also found that B.A. spanners fit the various sizes of keys."

SUNDERLAND EXHIBITION

THE Sunderland Model Boating and Engineering club has finished its seventeenth and most successful season. The noteworthy event was the holding of the first exhibition. This, supported by the neighbouring clubs, was visited by more than 1,200 spectators in 10 hours. The two photos show some of the models on view.

A busy season is anticipated with, passenger-hauling on the 250 ft. continous track, boat running, steering competitions, r.t.p. hydroplaning, and, we hope, car-racing. These events take place mostly on Saturday afternoons and Wednesday evenings; but activities take place on other evenings during the week.



A 1¼-in. scale coal-fired working model tractor by D. A. Wrangham

FACTORY METHODS
in the Home Workshop
by "1121"

THE lathe is probably the most used item of machine-tool equipment in the whole of the model engineer's workshop. Indeed, it is often the *only* machine-tool to be found there. Many ingenious and well-designed gadgets have been described in these pages, from time to time, to adapt this long-suffering machine for the performance of all sorts of duties for which it is basically more or less unsuitable; milling, grinding, sawing, shaping, gear-cutting, etc., are all heaped upon the unfortunate animal. The writer suggests that if the ingenuity which has been expended in the past in designing these various attachments, and the energy which has gone into their making were to be used in designing and building simple machines solely for accomplishing these various jobs, the jobs themselves could be done with rather greater ease, speed and accuracy. After all, why spend so much time in making a fairly elaborate device for, say, end-milling in the lathe, and then have to stand on your head with one eye shut in order to use it, when with no more work a proper little end-milling machine could be made, designed expressly to enable the job to be done in the most suitable way possible? One or two such machines *have* in the past been described in THE MODEL ENGINEER; the writer remembers a vertical miller and a hand shaper which were excellent examples of their kind.

The object of this particular article, however, is to show how the lathe can be assisted to do its *legitimate* work with greater efficiency by the fitting up of a few very simple attachments, as distinct from this practice of turning it into a rather "Heath Robinson" machine-shop on its own—a habit that would not be tolerated in a factory. Granted, we are not running a factory; but, if the system of specialisation which is the tendency in the large machine-shop is found to be best where time is money, surely we are not too proud to accept the doctrines of the experts with regard to our own time, which may be, by comparison, less valuable, but still not unlimited. When we make something, therefore, to do a job, let us concentrate on designing it to be as suitable as possible for that particular job, regardless of what existing equipment we may have on to which it can be hung to save ourselves an hour or two of work. Paradoxically as it may seem, we shall find that our new machine will be, in the long run, the most use in accomplishing any other jobs which may crop up in the future.

The main functions of the lathe may be summed up as: (a) turning to a certain diameter for a certain length, both externally and internally (i.e., boring); (b) facing a flat surface; (c) producing any variety of more or less irregular forms between the extremes of (a) and (b); and (d) sundry miscellaneous operations such as drilling, tapping, screw-cutting, knurling, etc., which have come to be recognised as part of the machine's normal job of producing parts of a circular form. Modern developments of lathe design have been directed at enabling the machine to do just this work, and no other, more quickly, more accurately, and less dependent on the human operator. If the amateur is desirous of improving his humble little machine he should see in which of these directions he can adapt the commercial lathe's principles.

Let us consider turning, by which we will understand all work that is performed by a tool held in a post of some sort on the cross-slide, or top-slide if one is being used. The writer has no top-slide on his 4-in. Drummond, and never misses it.

For production turning work where the tolerances on diameters are fairly wide, a fixed stop can be arranged to limit the inward travel of the cross-slide, at which position the tool is set to cut the required diameter. If the depth of metal to be removed is such that more than one cut is necessary, the "roughing" cuts can be taken at any depth the operator finds suitable, as long as the "finishing" cut is taken with the cross-slide against the stop. In any case, a more accurate finishing cut will be produced if a roughing cut is taken first, even if the depth to be cut does not warrant it on its own account. Where close accuracy is required, a graduated collar on the cross-slide handle is a great help. This can be set to "zero," giving a few "thou" over finished diameter with a thin shim inserted between the cross-slide and its stop. The work is then "miked," the shim removed, and the required amount taken off by means of the graduated collar.

Lengths are not usually so important, but precisely the same procedure can be followed, by using a stop to control the longitudinal movement of the saddle.

A large proportion of factory turning is done by means of the piece of equipment known as the "roller box," particularly where a comparatively long length is to be turned down to a small, flimsy diameter. The reader will know that this cannot be done easily with an ordinary tool in the tool-post, as whip in the material being turned causes the diameter at the unsupported end to exceed that near the shoulder; in other words, the work is tapered. It is not always possible to use a tailstock centre, apart from the fact that this introduces extra work in centring and changing centre-drill and centre; and, in any case, if the small diameter is long enough it can still spring away from the tool in the middle, even though supported at either end, and the work will come out barrel-shaped. The roller-box, besides holding a tool-bit, provides two rollers which are arranged to support the work in the directions of cut and thrust. The rollers go on ahead of the tool and are, therefore, supporting the work all the time just where the pressure comes.

The roller-box is operated from the tailstock of the lathe, and can form one of a series of tools such as drills, reamers, taps, etc., in a rotating turret, which automatically indexes round to each station, in turn, as the tools are withdrawn from the work.

The writer, for some years now, has used a scheme which follows the main principle of the roller-box, but operating from the ordinary tool-holder on the cross-slide, or top-slide as the case may be. The idea is shown in Fig. 1, and consists, as will be seen, of a piece of steel angle

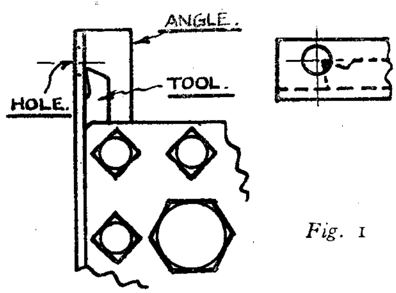


Fig. 1

in which the tool is clamped. The hole in the angle is a running fit over the stock in the chuck, and the tool is set to turn the required diameter. To get the hole in the angle in the right position, it should be centred, drilled and reamed in place from the headstock, and it should also be case-hardened before use. This method is particularly useful for turning long screws, as the length which can be run down without fear of whipping is limited only by the travel of the saddle. For the production of a fair number of screws or similar components of the same length, a longitudinal stop could be fitted up.

With regard to these stops, it may be remarked that the ideal arrangement is a little bracket attached to some part of the lathe bed, and carrying a long screw with a locking-nut. This can then be adjusted to stop the saddle at the required position. If the owner of the lathe does not wish to start drilling and tapping holes in his machine, and making and fitting special brackets, which may be in the way later on, a good substitute is a toolmaker's clamp on the bed, or even a piece of thickish plate lying on the bed, where it will get nipped between the saddle and the headstock. The toolmaker's clamp idea can also be applied as the stop to limit the travel of the cross-slide, when setting up for diameter.

The type of tool-holder to be used in any particular case depends greatly on the nature of the work. If several operations are required to be performed in turn, the four-way tool-holder saves an enormous amount of time which would otherwise be wasted in changing tools and adjusting and levelling each one, not forgetting that this destroys the setting and renders any system of stops useless, while if one tool only is required to do the job, it may be more convenient to hold this in a post of the American pattern. This takes up less room than any other type, and height adjustment is quicker and easier.

Parting Off

The writer uses an American tool-post on his Drummond whenever possible, but this was originally adopted of necessity by reason of the fitting of a parting-off blade on the back of the cross-slide. This meant that, with the lathe's original tool-holder set in the middle T-slot for small work, not only did the tool and the new parting-off blade meet in the middle, but they actually overlapped. It was therefore necessary to adopt some form of tool-holder which would bring the tool farther back, and the American type of post was the answer.

The idea of having the parting-tool more or less permanently in position on the back of the cross-slide is probably well known to the majority of lathe users ; but it is such a good thing that it is worth the risk of repetition to mention it, in case there may be any less-experienced readers who do not know of it. Also, it is such common practice in factory machine-shops, even on automatic machines, that it is well within the scope of these articles.

The holder for the parting-tool is usually a more or less fancy casting ; but it doesn't have

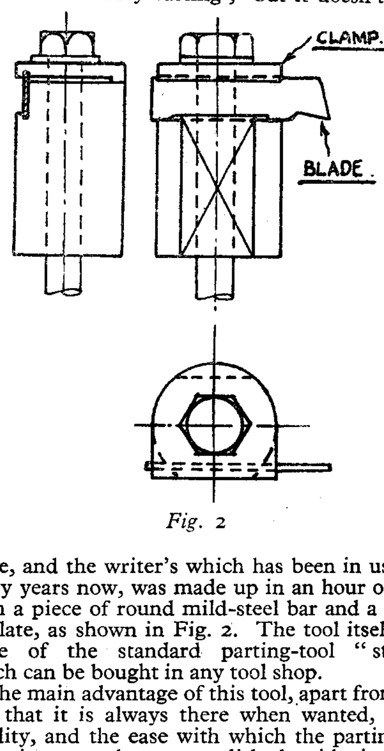


Fig. 2

to be, and the writer's which has been in use for many years now, was made up in an hour or two from a piece of round mild-steel bar and a scrap of plate, as shown in Fig. 2. The tool itself is a piece of the standard parting-tool "strip" which can be bought in any tool shop.

The main advantage of this tool, apart from the fact that it is always there when wanted, is its rigidity, and the ease with which the parting-off operation can be accomplished with its aid. Parting off is a job approached with fear and trembling, and one eye on the hacksaw, by those who have not discovered this method, particularly when the lathe is not in tip-top condition ; but with this gadget set up, we promise you that it will be so easy that you will find yourself parting off a little slice from the end of the bar rather than bothering to face the end.

(*To be continued*)

Editor's Correspondence

Planing Thin Material

DEAR SIR,—Whilst re-reading the article on the model Threshing Set, which appeared in THE MODEL ENGINEER a few weeks ago, I noted that your correspondent states that he was unable to plane the thin material used in the construction of his model.

I am a wood-worker by trade, and am very fond of fine cabinet work as a pastime; but, as materials for inlaying, etc., are almost unobtainable these days, I am obliged to cut out all my own lines, etc., for this purpose. To facilitate the planing of this very thin material, I have made up a simple "gadget," as follows :—

Take a piece of hardwood, about a foot long, and about 4 in. × 1 in. section, and plane up true all round. About ½ in. from one end cut a groove across the piece, about ⅜ in. wide and the same deep, and into this groove glue a hardwood stop, allowing it to stand up above the surface of the board a little less than the finished thickness of the work. I always use an ordinary wooden smoothing plane, finely set and kept very sharp, and have found little difficulty in planing material well under $\frac{1}{16}$ in. in thickness. The wooden stop is used as a safeguard against catching the plane iron on a metal stop, and thereby causing damage to the cutting edge.

I trust that the above, which is a well-known device among wood workers, will be of assistance to other model builders who find wood-working a little difficult.

Yours faithfully,

Tenterden. R. L. SWEATMAN.

Calorific Value of Fuels

DEAR SIR,—Regarding the letters on the above subject in the January 8th issue, might I suggest that both contributors are approaching the matter from the wrong angle; the power from any heat engine does not come directly from the fuels they consume, but *indirectly*, through the heat exchange to and from the medium employed, e.g. steam, in the steam engine; air, in the hot-air engine, and the products of combustion in the various forms of internal combustion engines. Now following this line, it becomes apparent that the object, in the reciprocating I.C. engine, is to pass the maximum amount of air through the highest heat cycle in the shortest possible time, subject to the avoidance of detonation. It follows that the smallest amount of fuel which will pass a given air charge through a given heat range will provide the greatest power output, since any increase in the quantity of fuel can only be at the expense of the air charge.

Since the optimum air-petrol ratio for maximum power is between 13-1 and 15-1 (weight), and for alcohol-benzole, between 9-1 and 10-1, it follows that, apart from any difference in the calorific values of the two fuels (other things being equal), the petrol will give the greater power, and taking the increased calorific value of the petrol, the balance is weighed decidedly in favour of petrol. As against this, however, we have the fact that most full-size racing engines give a greater power output on alcohol fuel than on petrol, so it becomes apparent that other factors can influence and indeed sometimes nullify any gain from the higher calorific value of petrol.

The first and most important of these factors is of course that the higher latent heat of evaporation of alcohol provides a refrigerant effect, which results in a cooler and, therefore, denser charge to reach the cylinder; but rather than consider this entirely as a virtue, we must regard it more as a palliative, and since prevention is better than a cure, it serves as a pointer to heat transfer in the wrong place.

In his article in the October 23rd issue, Mr. Mitchell gives some cylinder-head temperature figures for both petrol and alcohol—"carried out in still air at 6 degrees C."—if the rest of Mr. Michell's tests were carried out under similar conditions, the output curve for alcohol is always likely to be higher than for petrol, but no mention is made of the provision for cooling in this article. Mr. Cruickshank however, in his article of August 16th, 1945, mentions that—"During the later tests, signs of overheating became apparent, and I found it advisable to provide auxiliary cooling by way of an electric fan. Once again, the maximum B.H.P. was raised to 0.291 at 10,100 r.p.m."—thus showing the necessity of adequate cooling with petrol.

Later, in Mr. Mitchell's article, we find in his estimate of thermal efficiency—"Assuming a volumetric efficiency of 80 per cent., the volume of air per cycle will be 12 c.c."—he then goes on to add alcohol fuel to the charge in the ratio 1-9.57. Now, while this proportion of fuel would make little difference to the 12 c.c. in a liquid state, when thoroughly vaporised (as in an engine without other means of cooling), it would send the estimated 80 per cent. volumetric efficiency soaring, and render the resultant "guess" estimated figures worthless.

In conclusion, I do not wish this letter to be read in the light of destructive criticism or in any way belittling Mr. Mitchell's tests, but rather to give another interpretation of results which appear to be rather conflicting in the article under discussion.

Yours faithfully,

Birmingham. T. DALZIEL.

Lathe Headstock Bearings

DEAR SIR,—I read with interest the letter of Mr. W. H. Ellis in the January 22nd issue on the above subject. I have had a lathe, for some years, fitted with Timken roller-bearings, and have found that I can get an excellent tool finish on work without any evidence of chatter marks.

I have often wondered whether the cause of these chatter marks is due to the fact that the bearings have not been pre-loaded, when fitting. If they are fitted as in a car, chatter marks will result at once, but if pre-loaded then these will disappear.

On my lathe I have to tighten the locking-nut on the back of the mandrel, and then advance it a further two thous. for the load.

Yours faithfully,

Brenchley. C. C. LANGER.

Tide Mills

DEAR SIR,—As tide mills must now be almost obsolete and almost in the same category as beam engines, I wonder whether any of your readers can describe how they worked and what their capacity was. From the historical point of view the modelling of a tide mill might be interesting. I believe that at one time they were common on the Thames.

Yours faithfully,

Beccles. A. R. CROWFOOT.

Removing Lathe Mandrel

DEAR SIR,—I am wondering if you, or any of your readers, can advise me how to remove the mandrel from an old 5-in. Drummond lathe. The machine is back-geared, the 3-step pulley being loose on the mandrel, and the large gear fixed, but as the mandrel must be drawn out towards the tailstock, this large wheel butts against the taper front bearing, and locks it on to the mandrel when pressure is applied.

The fixing of the large gear on to the shaft is not visible, and gentle persuasion with a mallet is without effect. The removal is desired so as to fit a new front bearing.

Yours faithfully,

Banstead. A. S. HAWTHORNE.

Gas Turbines

DEAR SIR,—With reference to Mr. D. H. Chaddock's article on gas turbines I should like to make one or two comments.

My idea in using a reciprocating engine in place of the turbine was in order to gain experience in the running of the remaining components, without having to trouble about a doubtful proposition that a turbine presents at present in the small sizes. The uneven intake of hot gases to the reciprocator would have complications, but I think much useful experience would be gained. Obviously the engine has not the slightest claim to be called a gas turbine, the main argument being that a reciprocating engine cannot be called a turbine.

To term the valve-gear as working at a "Cherry Red" is a slight exaggeration. Steel with a cherry red appearance is usually considered to be in the region of 1,400 deg. F. I stated in my article (MODEL ENGINEER, November 27th, 1947), that a plant proportioned as in my calculations, would have a temperature of 1,220 deg. F. entering the turbine. The temperature entering the valves of the reciprocator would be less than this, due to the longer inlet manifold. In view of this I doubt if any colour would show. In addition, although the dimensions of the engine are scaled down, their strength at high temperatures is not. The engine should run for short periods ; and, if continuous running is required, then the proportion of air will have to be increased to lower the temperature. This, of course, involves a drop in efficiency.

I did not refer to a Rootes Blower, I stated Rootes type, which includes many far superior machines, such as those by Ljungstroms, which firm has achieved a volumetric efficiency of 92 per cent. and an adiabatic efficiency of 79 per cent. for a 6-in. compressor. I stated 80 per cent. efficiency against the low pressure of 5 lb. per sq. in. In my calculation in the article mentioned above I assumed 60 per cent. efficiency because of the higher compression ratio. It must be obvious from my calculations that the volumetric efficiency was being referred to.

I doubt if the energy lost through pressure drop in a regenerator is less than the large quantity of heat lost if such a component is not fitted.

The centrifugal impeller compressor is not the simple article Mr. Chaddock tends to imply. Besides the arguments "Arty" has made against this type of compressor, the ram compression, by which the large machine achieves a highly efficient (adiabatic) compression, is unobtainable in a small engine. The adiabatic efficiency of the effect is higher than most compressors.

Yours faithfully,

Greenock. A. H. POOLE, A.M.I.Mar.E.

Triple-geared Lathes

DEAR SIR,—I was very interested in the letter from Mr. Cleghorn in the January 22nd issue of THE MODEL ENGINEER. We have in use today a triple-geared lathe, 21-in. centres, with a geared faceplate similar to the one shown in the book referred to. But it is a very heavy lathe and was called by the makers a 21-in. centre break lathe. It has also a movable bed, so that we can make it into a gap about 5 ft. wide. The top bed slides on a base. This lathe must be over 70 years old, and is still doing good work. We are at the moment turning some fly-wheels, about 3 tons in weight, from the faceplate.

The only attention it has had is that, some years ago, the internal rim on the faceplate got very worn and caused a lot of jar on the work, so we cut this off and bolted a new machine-cut internal rim, with a machine-cut pinion. We also have another lathe which is triple-geared, and was made by Craven Bros., about 1904. This has all cut gears, and is a very substantial tool. Of course, the 21-in. lathe is a very heavy tool and has, as they say in Lancashire, plenty of "weft" about it. The tailstock has a hardened screw working against a hardened pad on the lathe spindle.

These references to old tools are always very interesting and the old workmen had something about them that we do not see today.

Yours faithfully,

Stalybridge. B. H. WAINWRIGHT.